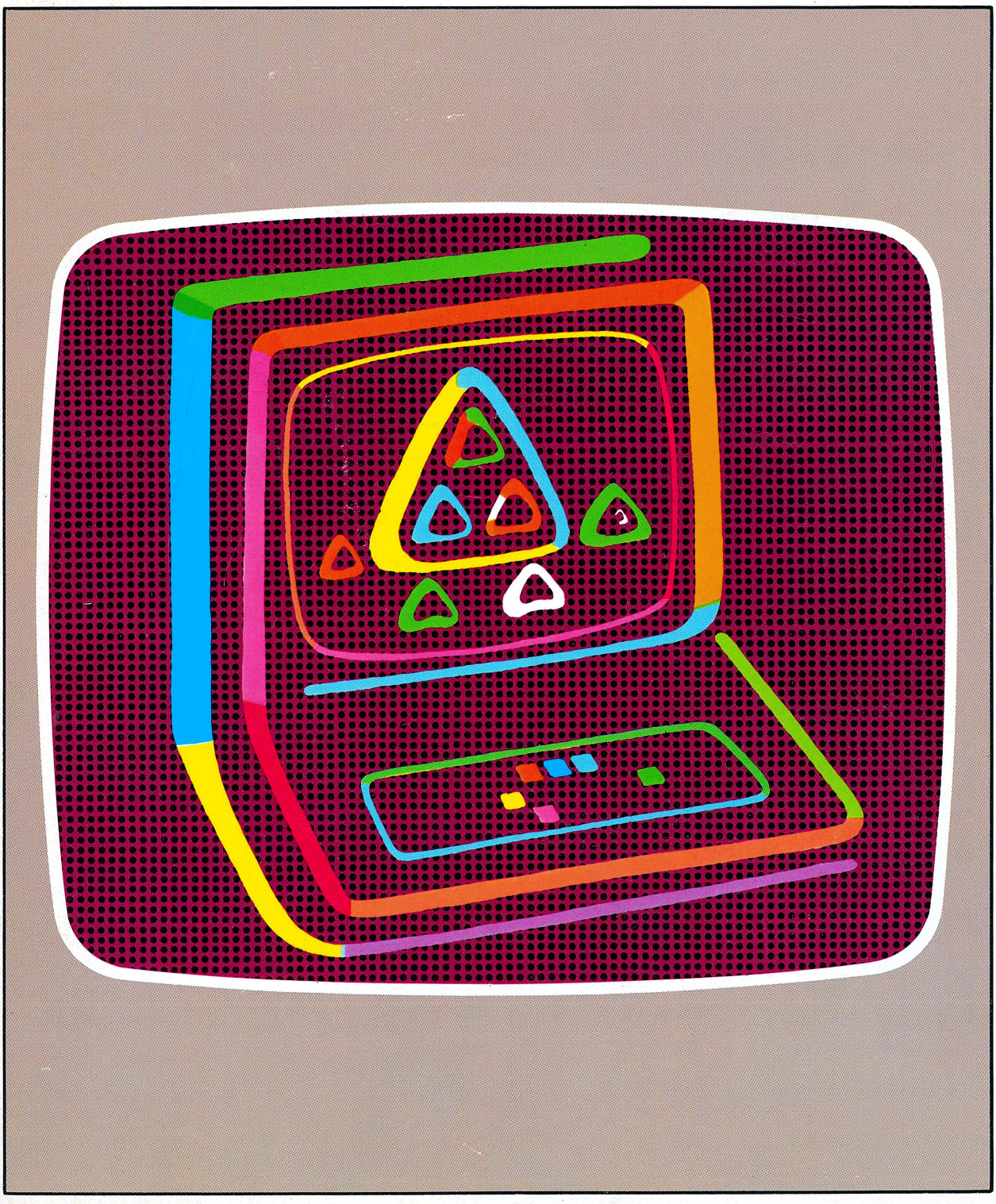
# LOGO
## FOR THE APPLE II/IIe/IIc



SPOTLIGHT 5

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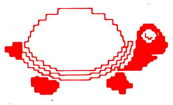
# Introduction: STARTING LOGO

## Read with Terry



Terry is unlike any other turtle you may know. Terry lives in your APPLE computer and can understand a special language—Logo. You will learn about Logo in this book. You will use Logo to direct Terry to create many different computer designs and pictures. First, you should know about some special keys on your APPLE. You will be using the keyboard to type directions for Terry.

← —The left arrow key will help you correct typing errors. It will delete, or erase, any letter or number to the left of the cursor.

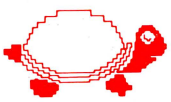
RETURN—The RETURN key sends directions you type to Terry. Press RETURN to have Terry follow your directions.

SHIFT—The SHIFT key allows you to type the symbols on the top half of some keys. You must press and hold SHIFT to type symbols such as a dollar sign or question mark.

Space bar—The space bar allows you to leave a blank space. Terry knows that a word is a group of letters with a space before and after them.

CTRL—The Control key is used with another key to give Terry special commands.

## Write with Terry



1. What language will you use to send directions to Terry?

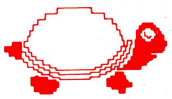
   _____

2. Which key will allow you to type symbols found on the top half of some of the APPLE's keys?
   a. the CTRL key
   b. the SHIFT key
   c. the left arrow key
3. What key do you press to have Terry follow your directions?

   _____

4. Which of the following sentences has three words for Terry?
   a. TERRYSPEAKSLOGO.
   b. YERRT SKAEPS OGOL.
   c. TERRY SPEAKSLOGO.
5. Which keys must you press to type a dollar sign ($)?
   a. CTRL and 4
   b. + and 4
   c. SHIFT and 4

## Read with Terry



Now that you know how to give Terry directions, it's time for you to meet the turtle. To begin your adventures with Terry, you must load the Logo language into your APPLE computer. Take the APPLE Logo disk out of its envelope and place it in the disk drive. Close the door of the drive. Turn on the TV or monitor and the computer's power switch. In a few seconds, the red light on the drive will go out and you will see a message on the screen. Press the RETURN key. Soon you will see

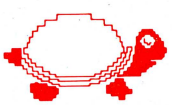
```
WELCOME TO LOGO
? ■
```

The question mark is called a prompt. This symbol tells you that Terry is waiting for you to type some directions. The flashing rectangle is called a cursor. The cursor shows where the next letter, number, or symbol you type will appear. But where is Terry? The turtle is waiting for you to tell it to appear. Type

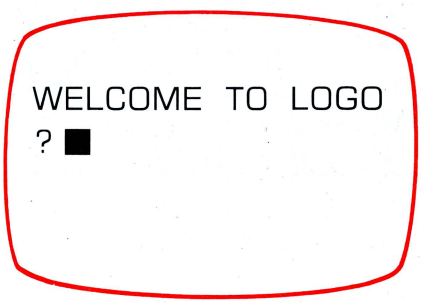
```
SHOWTURTLE
```

next to the prompt. Then press RETURN. Terry is the small triangle in the center of your screen. The prompt and the cursor have moved to the bottom of the screen. Terry is now ready to receive directions from you.

## Write with Terry



1. Look at the computer screen.
   Which symbol is the cursor? _____
   Which symbol is the prompt? _____




2. What does the prompt symbol tell you?

   _____

   _____

3. What does the cursor show you?

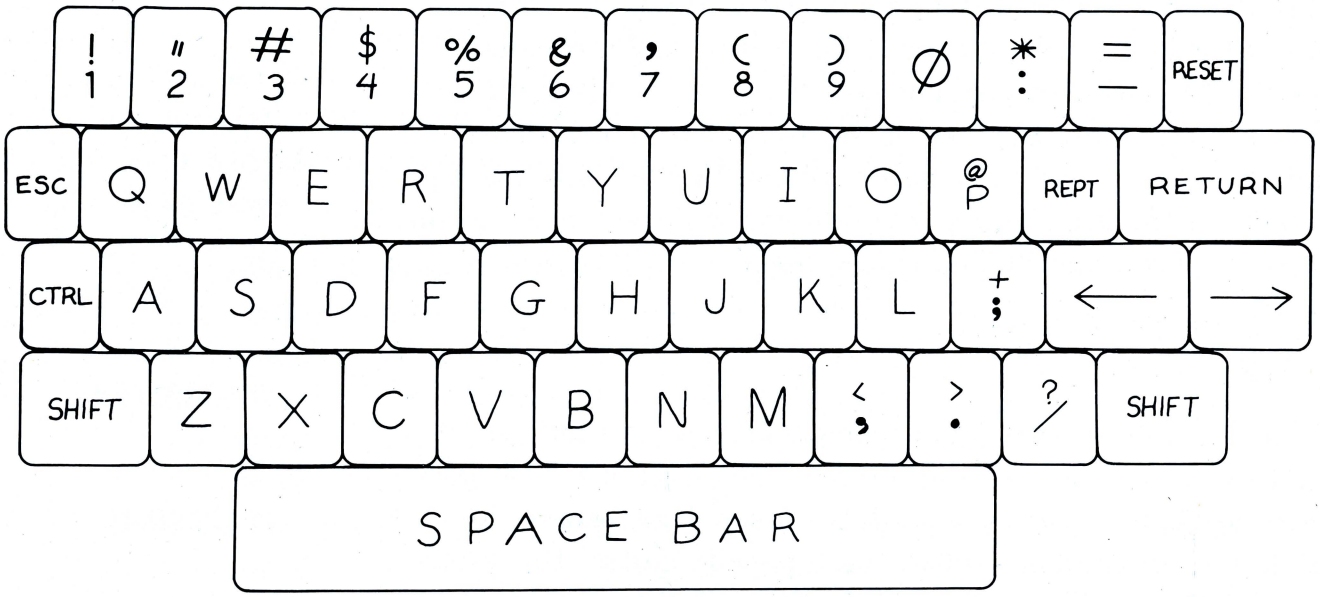
   _____

   _____

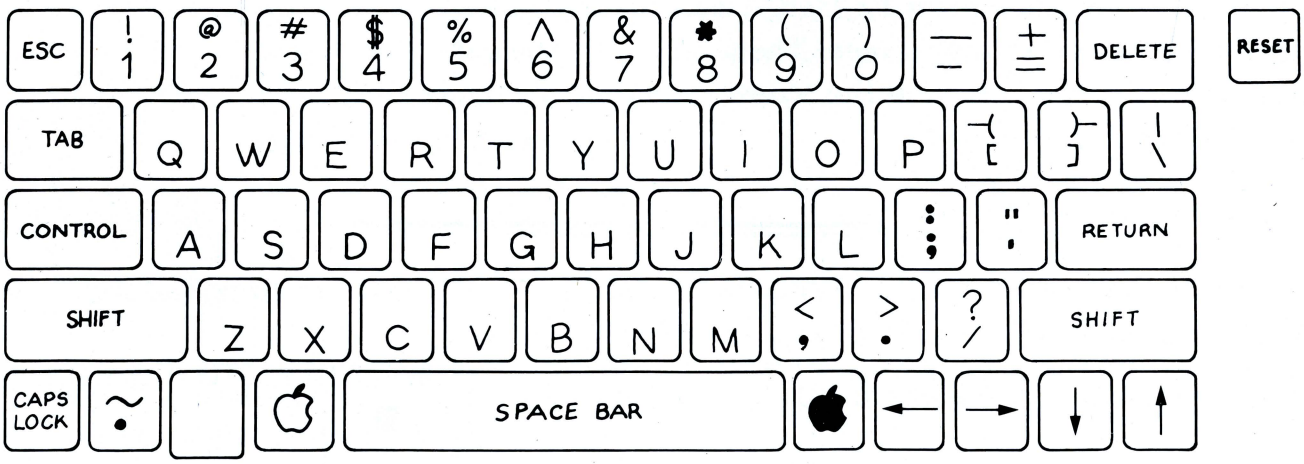
4. What word must you type to make Terry appear on the screen?

   _____

## Apple II Keyboard




## Apple IIe and IIc Keyboard

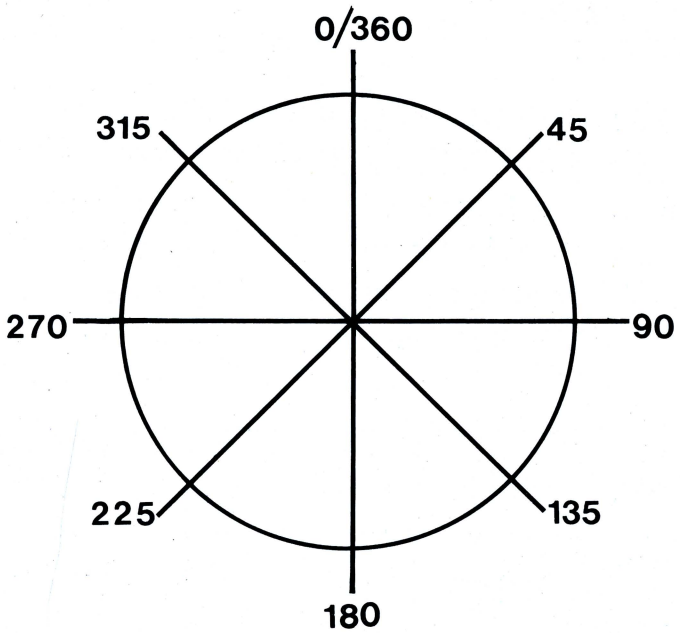



## Control Commands

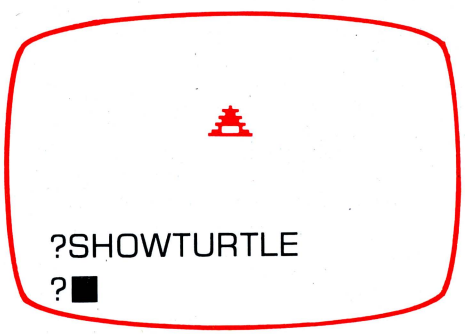
CTRL-A moves the cursor to the beginning of the line
CTRL-B moves the cursor back one space
CTRL-C leaves the Logo Editor
CTRL-E moves the cursor to the end of the line
CTRL-F moves the cursor forward one space
CTRL-G stops a recursive procedure
CTRL-L makes the entire screen into a graphics screen
CTRL-N moves the cursor down one line

CTRL-P moves the cursor up one line
CTRL-S makes the screen the normal screen with four lines for text
CTRL-T makes the entire screen into a text screen for writing commands and procedures

## 360° Compass for Turns and Circles



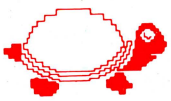

## Screen with SHOWTURTLE



# CHAPTER 1: Meet the Turtle

## LESSON 1

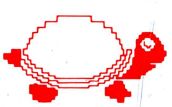
### Read with Terry



Terry knows how to move in two directions. The turtle can move FORWARD and BACK. In order for Terry to move, you must decide two things. First, you must decide the direction in which Terry will move. Then, you must decide how many turtle steps Terry will move. Finally, you must type the directions for Terry to follow. Don't forget to press RETURN to send each direction to Terry!

Liz typed FORWARD 50 and pressed RETURN. Terry moved FORWARD fifty turtle steps. Then Liz typed BACK 100 and pressed RETURN. Terry moved BACK one hundred turtle steps. Finally, Liz decided to start over. She typed CLEARSCREEN and pressed RETURN. Terry's lines disappeared, and the turtle moved back to its home at the center of the screen.

### Write with Terry



**1.** Circle the directions which are written correctly.

a. FORWARD 23
b. BACK100
c. 34 FORWARD
d. BACK 75
e. 41 STEPS BACK
f. GO FORWARD 30 STEPS

**2.** Which key must you press to send each direction to Terry?

_____

**3.** Name the two directions in which Terry can move.

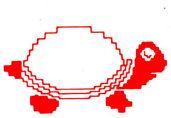
_____

**4.** Name two things that happen when you type the command CLEARSCREEN.

_____

_____

### Terry's Drawings



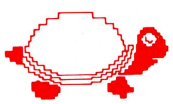
Juan wanted to find out how many turtle steps FORWARD Terry could take to reach the top of the screen. He typed the command FORWARD 150 and pressed RETURN. Terry disappeared from the screen! At the top of the next page are two ways Juan used to get Terry back on the screen.

```
?BACK 150
```

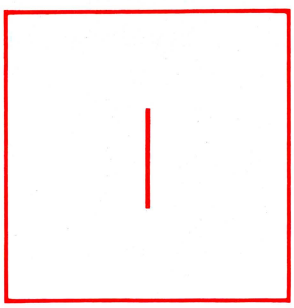
```
?BACK 50
?BACK 50
?BACK 50
```

Find out how many turtle steps FORWARD the turtle can take to reach the top of your screen.

## Draw with Terry



1. Look at the directions below. Then look at Terry's drawing on the sample screen at the right. Draw the place where Terry appears after the directions are followed.

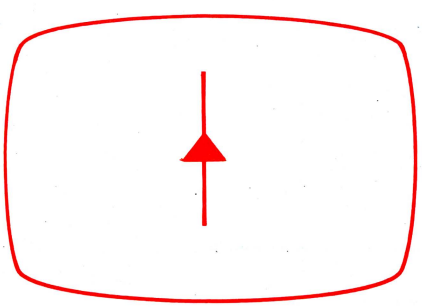


```
?FORWARD 100
?BACK 100■
```

2. Find out how many turtle steps Terry must take to reach the bottom of your screen. Be sure that Terry doesn't disappear! Write your directions on the lines.

3. Find out how many turtle steps Terry must take to travel from the top to the bottom of your screen. Write your directions on the lines.

4. Look at the turtle drawing below. Write three FORWARD and three BACK directions for Terry to make this turtle drawing on your screen.

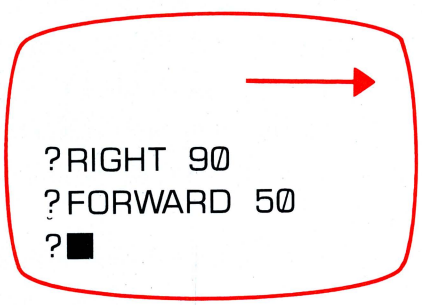


# LESSON 2

## Read with Terry

The turtle knows two more movements. Terry can turn LEFT and turn RIGHT. In order for Terry to turn, you must decide two things. First, you must decide whether Terry will turn to the LEFT or to the RIGHT. Then, you must decide how many degrees Terry will turn.

Keith typed RIGHT 90 and pressed RETURN. Terry pointed to the side of the screen, but did not draw a line. Then Keith typed FORWARD 50, and Terry drew the figure you see below.




You can use LEFT, RIGHT, FORWARD, and BACK to tell Terry how to draw many interesting designs.

## Write with Terry

**1.** Circle the directions which are written correctly.

a. RIGHT45
b. RIGHT 31
c. 2 DEGREES LEFT
d. LEFT 42

**2.** Name the two directions in which Terry can turn.

_____

**3.** What does Terry do when you type LEFT 90?

_____

**4.** Name two things you must tell the turtle before it can turn.

_____

_____

## Terry's Drawings

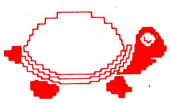
Mai Lee knew that if she typed LEFT 90 Terry would turn and point to the left side of her screen. She typed LEFT 90 twice, and Terry turned and pointed to the bottom of the screen.

?LEFT 90

?LEFT 90
?LEFT 90

Find out how many different directions you can type to make Terry turn and point to the bottom of your screen. Don't forget to press RETURN after each direction.

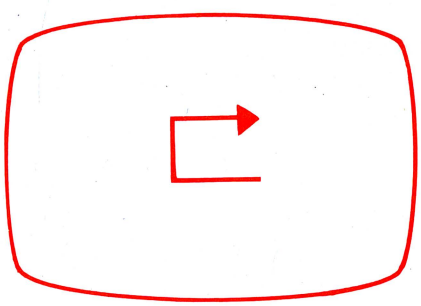
## Draw with Terry



1. Look at the directions below. Then draw Terry's picture on the sample screen.

?FORWARD 100
?RIGHT 90
?FORWARD 100

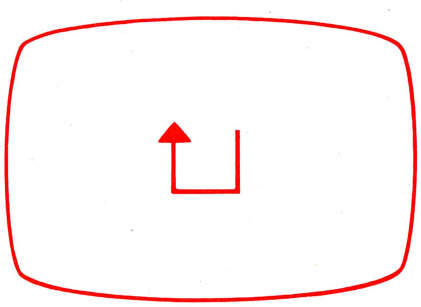
2. Look at the turtle drawing below. Write the missing lines to teach Terry to draw this shape.



?LEFT 90
?FORWARD 25

?FORWARD 25
?RIGHT 90

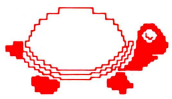
3. Look at the turtle drawing below. Write a set of directions to teach Terry to draw this figure.



4. Teach Terry to draw any design you choose. Use a separate piece of paper to draw the design and write the directions.

# LESSON 3

## Read with Terry



Gina wanted Terry to turn and point to the upper right corner of her screen. She knew that the command RIGHT 90 would make Terry turn right and point to the side of her screen. Gina decided that Terry would have to turn about half this distance to face the corner. Since half of 90 is 45, Gina typed RIGT 45. She saw her mistake before she pressed RETURN. Gina fixed this by pressing the ← key four times. Now her direction read

```
?RIG■
```

Gina typed the rest of the direction, pressed RETURN, and Terry turned and faced the right corner of her screen.

Nick wanted Terry to turn 90 degrees to the left. He typed the command LFT 90 and pressed RETURN. Terry didn't understand Nick's direction, so the message I DON'T KNOW HOW TO LFT appeared on the screen. This is called an error message. Nick typed the command over, and Terry turned left.

## Write with Terry

1. What error message will appear for each wrong direction?

   a. BAKC 60

   _____

   b. 45RIGHT

   _____

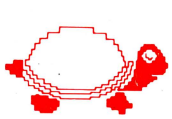
2. Tell how to correct this message before you press RETURN.

   FORWARD5

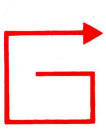
   _____

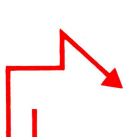
   _____

## Terry's Drawings



Erica wrote directions for Terry to draw each of these pictures. Choose one of these and have Terry draw it on your screen.

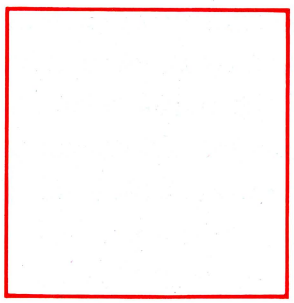




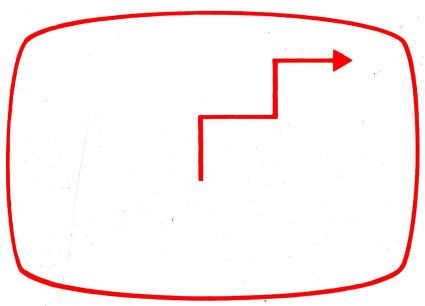
## Draw with Terry

**1.** Look at the directions below. Then draw Terry's picture on the sample screen.

```
?RIGHT 45
?FORWARD 50
?BACK 100
```

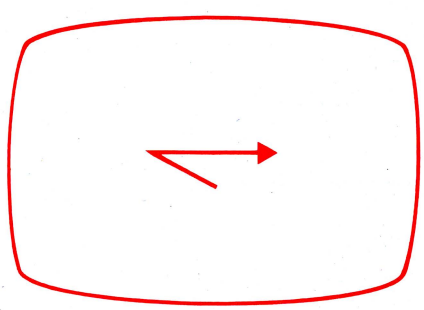


**2.** Look at the turtle drawing below. Write the missing lines to teach Terry to draw this shape.



```
?FORWARD 20
?RIGHT 90
_____
_____
?FORWARD 20
_____
_____
```

**3.** Write the missing lines to teach Terry to draw this shape.



```
_____
?FORWARD 30
_____
?FORWARD 50
```

**4.** Teach Terry to draw a large X on your screen. Use a separate piece of paper for your directions.

# CHAPTER 2: Designing with the Turtle

## LESSON 1

### Read with Terry

Bruce wanted Terry to draw a line around the edge of the screen. He did not want any other turtle lines on the screen. Terry knows how to move anywhere on the screen without leaving turtle tracks behind. Terry can do this by putting the turtle pen in an UP position. Bruce typed these directions

```
?PENUP
?LEFT 90
?FORWARD 132■
```

Terry turned LEFT 90 degrees and moved FORWARD 132 turtle steps, but did not draw a line. The PENUP command told Terry to follow all directions without drawing a line. Then Bruce typed

```
?RIGHT 90
?PENDOWN
?FORWARD 110■
```

Terry turned RIGHT, put the turtle pen in a DOWN position, and drew a line 110 turtle steps long.

Remember, if you tell Terry to PENUP, the turtle will not draw any lines until you tell it to PENDOWN.

### Write with Terry

1. What does the PENUP command tell Terry to do?

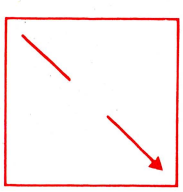
_____

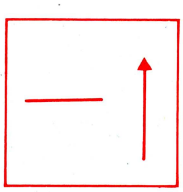
2. What does the PENDOWN command tell Terry to do?

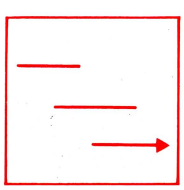
_____

### Terry's Drawings

Jenny wrote directions for Terry to draw each of these designs. Choose one of these and teach Terry to draw it on your screen.



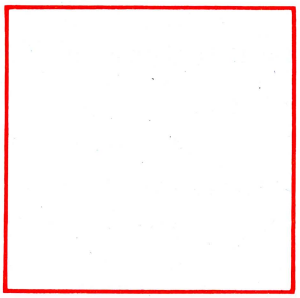




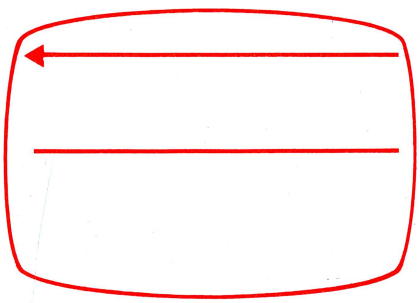
## Draw with Terry

**1.** Read the directions below. Then draw Terry's picture on the sample screen.

```
?PENUP
?FORWARD  30
?RIGHT  90
?FORWARD  30
```

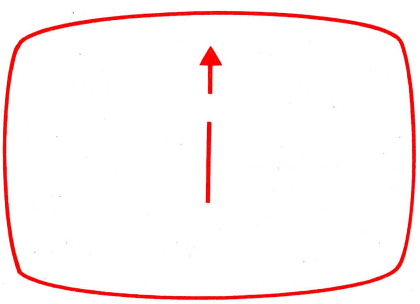


**2.** Look at the turtle drawing below. Write the missing lines to teach Terry to draw this shape.



```
?LEFT  90
?PENUP
?FORWARD  132
?PENDOWN
?BACK  264
?RIGHT  90
?PENUP
?FORWARD  110
?LEFT  90
```

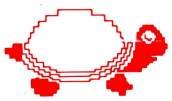
**3.** Write the missing lines to teach Terry to draw this shape.



```
?FORWARD  50
?FORWARD  25
?FORWARD  25
```

**4.** Teach Terry to write the word "HI" on your screen. Write the directions on a piece of paper.

## Read with Terry



Andy typed the following directions for Terry.

```
?FORWARD 30
?RIGHT 90
?FORWARD 30
?RIGHT 90
?FORWARD 30
?RIGHT 90
?FORWARD 30
?RIGHT 90■
```

Terry's shape had four equal sides and four right angles. Andy taught Terry to draw a square. "I can make many designs with this shape," Andy thought. "But I must type a lot of information for Terry. Maybe there is a shortcut."

Rachel knew a faster way to teach Terry to draw a square. She typed these directions.

```
?REPEAT 4 [FORWARD 30 RIGHT 90]
```

Terry followed Rachel's directions by moving FORWARD 30 turtle steps. Then Terry turned RIGHT 90 degrees. The turtle REPEATed these directions four times to draw a square.

Do you know how Rachel made the left ( [ ) and right ( ] ) brackets? She pressed SHIFT and N for the left bracket. Then she pressed SHIFT and M to make the right bracket. (On the Apple IIe, the left and right brackets are on the keyboard.)

## Write with Terry

**1.** What is a shorter way to type these directions?

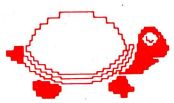
```
?FORWARD 10
?RIGHT 45
?FORWARD 10
?RIGHT 45
```

_____

**2.** Write this direction another way on the next page.

```
?REPEAT 4 [FORWARD 50 RIGHT 70]
```

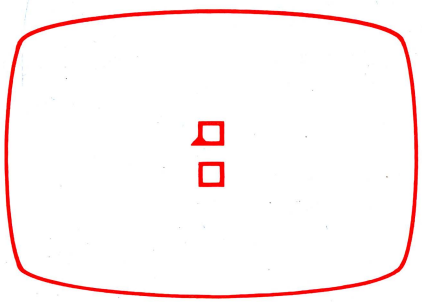
## Draw with Terry



**1.** Look at the directions below. Then draw Terry's picture on the sample screen.

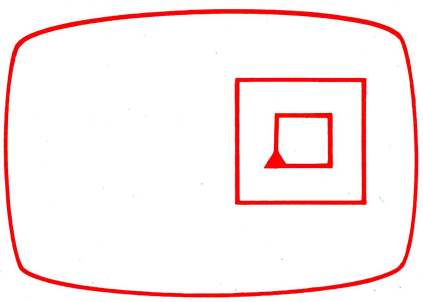
```
?REPEAT 4 [FORWARD 15 RIGHT 90]
?REPEAT 4 [FORWARD 20 RIGHT 90]
?REPEAT 4 [FORWARD 25 RIGHT 90]
```

**2.** Look at the turtle drawing below. Write the missing lines to teach Terry to draw this shape.



```
?REPEAT 4 [FORWARD 25 RIGHT 90]
?PENUP
?FORWARD 50
```

**3.** Write the missing lines to teach Terry to draw this design.

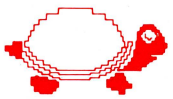


```
?REPEAT 4 [FORWARD 100 RIGHT 90]
?FORWARD 25
?RIGHT 90
?FORWARD 25
?REPEAT 4 [FORWARD 50 RIGHT 90]
```

**4.** Teach Terry to draw a robot face. Use a large square for the head and smaller squares for the eyes, nose, ears, and mouth.

# LESSON 3

## Read with Terry



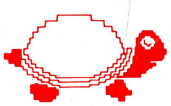
Terry can draw any shape you know. Tony wrote the following directions for Terry.

```
?REPEAT 2 [FORWARD 20 RIGHT 90 FORWARD 50
 RIGHT 90]
```

Terry moved FORWARD 20 steps, then turned RIGHT 90 degrees. Terry continued the drawing by moving FORWARD 50 turtle steps and making another 90 degree turn to the RIGHT. The turtle did this two times because the instructions told it to REPEAT 2 times. Tony taught Terry to draw a rectangle!

Tony knew that rectangles are shapes with opposite equal sides and four right angles. If all four sides are equal, then the rectangle is called a square.

## Write with Terry



1. Anna wrote these directions for Terry. What shape did Terry draw?

```
?REPEAT 4 [FORWARD 100 RIGHT 90]
```

_____

2. Ed wrote these directions. What shape did Terry draw?

```
?REPEAT 2 [FORWARD 50 RIGHT 90
 FORWARD 25 RIGHT 90]
```

_____

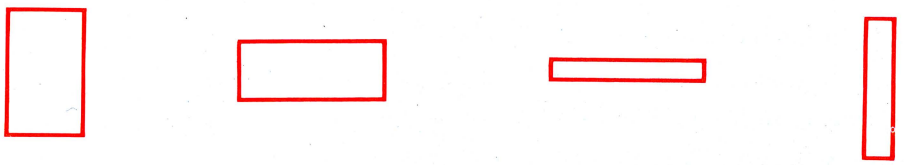
3. Write these directions another way.

```
?FORWARD 30
?RIGHT 90
?FORWARD 60
?RIGHT 90
?FORWARD 30
?RIGHT 90
?FORWARD 60
?RIGHT 90
```

_____

## Terry's Drawings

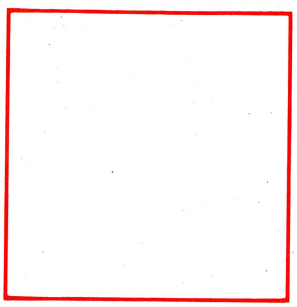
Ellen wrote directions for Terry to draw these designs. See how many different rectangles you can teach Terry to draw.



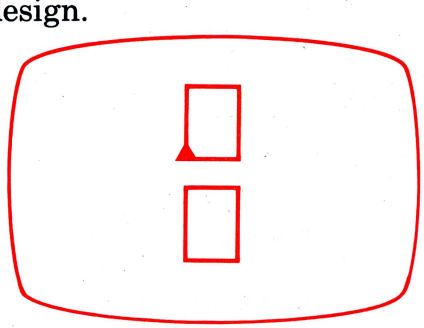
## Draw with Terry

**1.** Read the directions below. Then draw Terry's drawing on the sample screen.

```
?REPEAT 2 [FORWARD 20 RIGHT 90
  FORWARD 50 RIGHT 90]
?REPEAT 2 [FORWARD 40 RIGHT 90
  FORWARD 70 RIGHT 90]
```

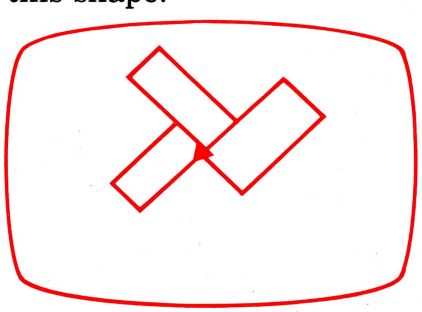


**2.** Look at the turtle drawing below. Write the missing lines to teach Terry to draw this design.



```
?REPEAT 2 [FORWARD 50 RIGHT 90
  FORWARD 25 RIGHT 90]
_____
?FORWARD 60
?PENDOWN
_____
```

**3.** Write the missing lines to teach Terry to draw this shape.



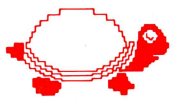
```
?RIGHT 45
?REPEAT 2 [FORWARD 50 RIGHT 90
  FORWARD 25 RIGHT 90]
_____
_____
?LEFT 90
_____
```

**4.** Teach Terry to draw a city scene from squares and rectangles.

# CHAPTER 3: More Turtle Designs

## LESSON 1

### Read with Terry



Terry found these directions on the screen:

```
?REPEAT 3 [FORWARD 60 RIGHT 120]
```

The turtle followed the directions by moving FORWARD 60 turtle steps and turning 120 degrees to the RIGHT. Terry REPEATed these directions three times and made a shape with three sides and three angles. What is Terry's shape called?

The REPEAT command saves a lot of typing time. Another way to save time typing is to use abbreviations for some turtle commands. Here are some abbreviations you can use.

| COMMAND | ABBREVIATION |
|---|---|
| FORWARD | FD |
| BACK | BK |
| LEFT | LT |
| RIGHT | RT |
| SHOWTURTLE | ST |
| CLEARSCREEN | CS |

Now you can teach Terry to draw a triangle by typing

```
?REPEAT 3 [FD 60 RT 120]
```

### Write with Terry

1. Write the abbreviation for each turtle command.

SHOWTURTLE _____ BACK _____

RIGHT _____ FORWARD _____

CLEARSCREEN _____ LEFT _____

2. How many sides and angles does Terry have to draw to make a triangle?

_____

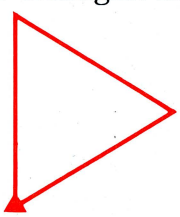
3. What shape will these directions teach Terry to draw?

```
?REPEAT 4 [FD 60 LT 90]
```

_____

## Terry's Drawings

Brian typed REPEAT 3 [FD 50 RT 120] to teach Terry to draw a triangle. Make a larger triangle. Make a smaller triangle.

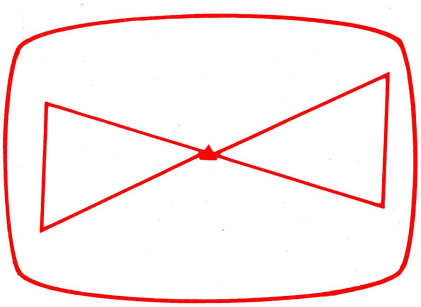


## Draw with Terry

**1.** Read the directions below. Then draw Terry's picture on the sample screen.

```
?REPEAT 3 [FD 50 RT 120]
?REPEAT 3 [FD 50 LT 120]
```

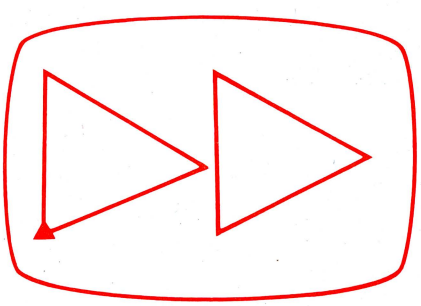
**2.** Look at the turtle drawing below. Write the missing lines to teach Terry to draw this design.



```
?LT 120
?REPEAT 3 [FD 75 RT 120]
?LT 120
```

_____

**3.** Write the missing lines to teach Terry to draw this design.



```
?REPEAT 3 [FD 100 RT 120]
?PENUP
```

_____

```
?FD 100
```

_____

```
?RT 90
```

_____

**4.** Teach Terry to draw a pinwheel made of four triangles.

_____

## Read with Terry

Carmen decided to make a design with three triangles in a row. She typed the directions for the middle and left triangles. Then, she moved the turtle to the right and typed

```
?REPEAT 4 [FD 40 RT 120]
```

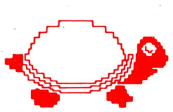
After she pressed RETURN, Carmen realized that she had made a mistake. She knew that CS would erase all the turtle lines on the screen. But, Carmen's first two triangles were correct. She just wanted to erase the last one. Pat saw Carmen's problem and told her about a new command—PENERASE. This command would turn Terry's pen into an eraser! Carmen solved her problem by typing

```
?PE          (the abbreviation for PENERASE)
?REPEAT 4 [FD 40 RT 120]
?PENDOWN (This allows Terry to draw again.)
```

After the mistake was erased, Carmen typed the directions for the last triangle.

Remember, Terry must be told to put the turtle pen down after the PE command is used.

## Write with Terry



**1.** What is the abbreviation for PENERASE?

_____

**2.** Which command must be used after PE so Terry can draw?

_____

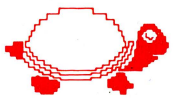
**3.** Jeremy wrote these directions for Terry to draw a triangle.

```
?REPEAT 4 [FD 50 RT 120]
?PE
?REPEAT 4 [FD 50 RT 120]
?REPEAT 3 [FD 50 RT 120]
```

Why didn't Terry draw the triangle?

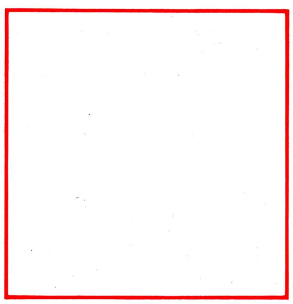
_____

## Draw with Terry

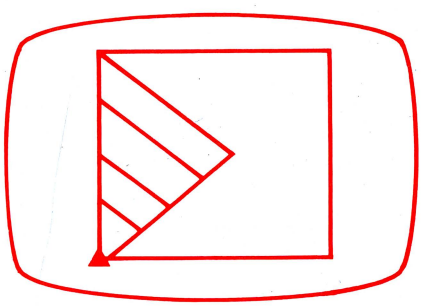


**1.** Read the directions below. Then draw Terry's picture on the sample screen.

```
?REPEAT 3 [FD 50 RT 120]
?FD 100
?PE
?BK 50
?PD
```

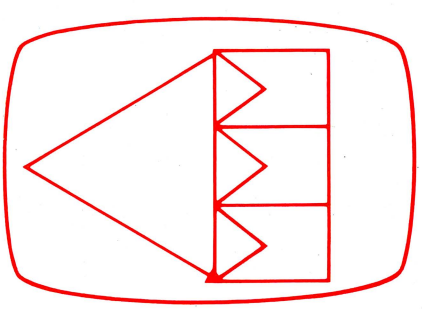


**2.** Look at the turtle drawing below. Write the missing lines to teach Terry to draw this design.



```
?REPEAT 3 [FD 100 RT 120]
?REPEAT 3 [FD 75 RT 120]
_____
_____
?REPEAT 4 [FD 100 RT 90]
```

**3.** Write the missing lines to teach Terry to draw this shape.



```
?REPEAT 4 [FD 50 RT 90]
?REPEAT 3 [FD 50 RT 120]
?FD 50
_____
_____
?BK 100
_____
?REPEAT 3 [FD 50 RT 120]
_____
```

**4.** Teach Terry to draw a silly face. Use a square for the head, rectangles for the eyes and mouth, and triangles for the nose and hat.

## LESSON 3

### Read with Terry

Have you noticed that Terry always appears somewhere in your designs? There are times when this is fine, but there are also times when the drawing would look better without Terry. There is a polite way to tell Terry to disappear. Just type the Logo word HIDETURTLE, and Terry will disappear.

The turtle can continue to draw designs while it is invisible. When you are ready for Terry to appear again, just type SHOWTURTLE and Terry will be visible once more.

There are abbreviations for these commands. Study the list below to learn these and some other abbreviations.

| COMMAND | ABBREVIATION |
|---|---|
| HIDETURTLE | HT |
| SHOWTURTLE | ST |
| PENUP | PU |
| PENDOWN | PD |

### Write with Terry

1. What happens when you type the Logo word HIDETURTLE?

   _____

2. Which command do you type to make Terry visible on your screen?

   _____

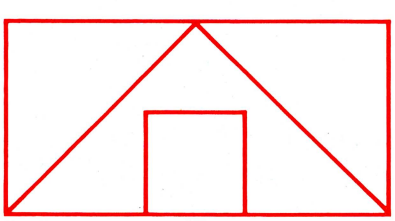
3. Write the abbreviation for each word.

   PENDOWN _____ SHOWTURTLE _____

   PENUP _____ HIDETURTLE _____

### Terry's Drawings

Abdul made this design with the turtle in its hidden state. Try to make a design while Terry is invisible.

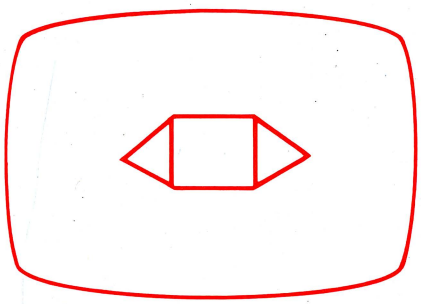


## Draw with Terry

1. Read the directions below. Then draw Terry's picture on the sample screen.

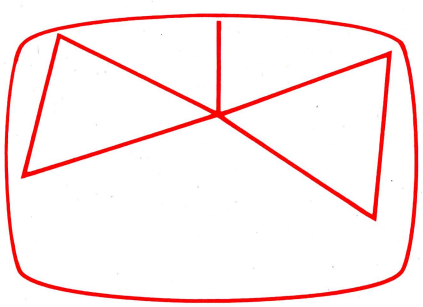
```
?LT 90
?REPEAT 2 [FD 100 RT 90 FD 50 RT 90]
?RT 180
?REPEAT 2 [FD 100 RT 90 FD 50 RT 90]
?HT
```

2. Look at the turtle drawing below. Write the missing lines to teach Terry to draw this design.



```
?PU
?FD 100
?RT 180
_____
_____
?REPEAT 4 [FD 50 RT 90]
?REPEAT 2 [FD 50 RT 90]
_____
?HT
```

3. Write the missing lines to teach Terry to draw this design.



```
?RT 45
?REPEAT 3 [FD 100 RT 120]
_____
_____
_____
?FD 100
?HT
```

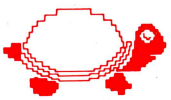
4. Write directions for Terry to draw a row of houses.

_____

# CHAPTER 4: Teaching the Turtle

## LESSON 1

### Read with Terry



Each time you want Terry to draw a square, you must type the directions for a square. A faster way is to write the directions in a **procedure.** Procedures are ways to teach Terry to draw a certain shape each time you give the turtle a command. Here is a procedure to teach Terry to draw a square.

```
?TO SQUARE
>REPEAT 4 [FD 65 RT 90]
>END
```

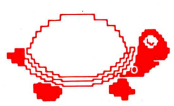
The first line, TO SQUARE, is the name of the procedure. The word TO tells Terry that you are writing a procedure. The word SQUARE tells Terry that the command to draw this shape is SQUARE.

The second line begins with a > for the prompt. This reminds Terry that the directions are part of a procedure named TO SQUARE.

The last line in this procedure also begins with a > for the prompt. The word END tells Terry that you finished typing the directions for this shape.

After you press RETURN, the words SQUARE DEFINED appear on the screen. The next line shows you the ? prompt and the blinking cursor. To see Terry draw a square, just type the command SQUARE and press RETURN.

### Write with Terry



1. What is a procedure?

   _____

   _____

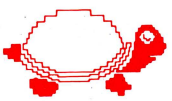
2. What symbol is a prompt for a procedure? _____
3. Write a procedure named TO TRI to teach Terry to draw a triangle 23 units long on each side.

   _____

   _____

   _____

## Draw with Terry

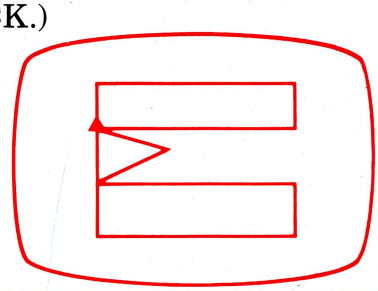


**1.** Read the directions below. Then draw Terry's picture on the sample screen.

```
?TO BRICK
>REPEAT 2 [FD 30 RT 90 FD 60 RT
  90]
>END
```

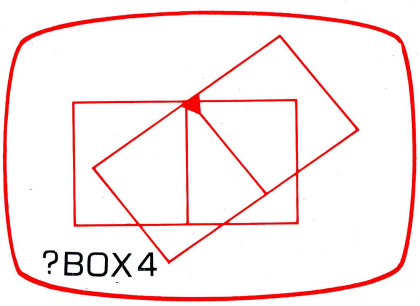
?BRICK

**2.** Look at the turtle drawing below. Write the missing lines to teach Terry to draw this shape. (Hint: Terry knows how to BRICK.)



```
?TO TRIO
>REPEAT 3 [FD 30 RT 120]
_____
?BRICK
?FD 30
_____
_____
_____
```

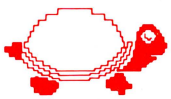
**3.** Write the missing lines to teach Terry to draw this design.




```
?TO BOX
>REPEAT 4 [FD 50 RT 90]
_____
?TO BOX4
>RT 45
_____
_____
>BOX
_____
_____
_____
_____
>END
```

**4.** Teach Terry to draw the pinwheel you made on page 19. Write the directions in a procedure to make two pinwheels on your screen.

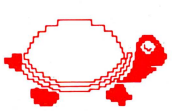
## Read with Terry



Another way to write procedures is to use the Logo Editor. Then you can correct any typing errors you may make. Here is a procedure for a square that is typed in the Logo Editor.

| | |
|---|---|
| ?EDIT "BOX | Tells Terry that you are going to write a procedure named BOX in the Logo Editor. Don't forget to use one quotation mark (") before the name of your procedure. |
| TO BOX<br>REPEAT 3 [FD 35 RT 90]<br>END■ | The title of your procedure appears at the top of a new screen. The words LOGO EDITOR at the bottom remind you that you are writing in the edit mode. Now is the time for you to write your procedure. |
| LOGO EDITOR | Did you notice a mistake in the second line? Just press CTRL-B to move the cursor back to the space after the 3. Now use the ← to erase the 3 and type a 4. Bring the cursor forward to the right of the word END by pressing CTRL-F several times. Now, press CTRL-C. This lets you leave the Logo Editor. |
| BOX DEFINED<br>?■ | Terry now knows the procedure to draw a box! Just type the command BOX. |

## Write with Terry



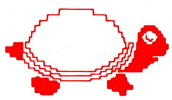
1. Circle the procedure names which are written correctly.
   a. EDIT "ME"
   b. EDIT "BRICK
   c. TO "NANCY
   d. TO FRANK
2. Which two keys must you press to move the cursor forward in the Logo Editor?

   _____
3. Which two keys must you press to move the cursor backward in the Logo Editor?

   _____
4. Which two keys must you press to leave the Logo Editor?

   _____

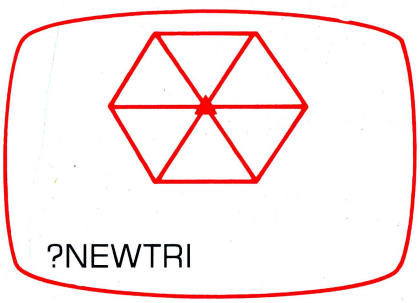
## Draw with Terry



**1.** Read the directions below. Then draw Terry's picture on the sample screen.

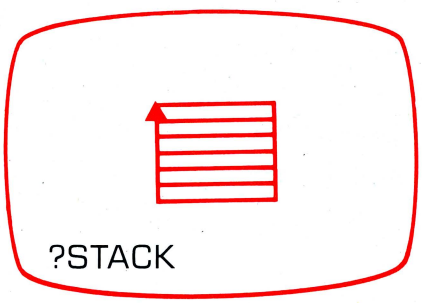
```
?TO SMSQUARE
>REPEAT 4 [FD 25 RT 90]
>END
?TO FIVESQUARES
>REPEAT 5 [SMSQUARE LT 90 FD
  50]
>END
```

**2.** Look at the turtle drawing below. Write the missing lines to teach Terry to draw this design.




```
?TO TRI
_____________________
>END
?TO NEWTRI
_____________________
>END
```

**3.** Write the missing lines to teach Terry to draw this procedure named STACK.

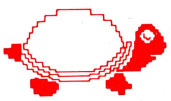



```
?TO BRICKS
>REPEAT 2 [FD 20 RT 90 FD 40 RT 90]
>END
_____________________
_____________________
_____________________
```

**4.** Write a procedure to teach Terry to draw a house. Use a procedure named TOP for the roof, and another named BOTTOM for the house. Put the two procedures together in a new procedure named HOUSE.

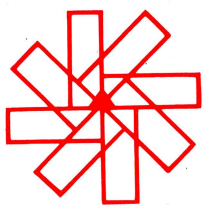
# LESSON 3

## Read with Terry



Alan wrote a procedure to teach Terry to draw a design with rectangles. First, he wrote a procedure for a rectangle, EDIT "RECT, and pressed CTRL-C. Then he typed the words EDIT "FLOWER and used RECT in a new procedure named FLOWER. Here is Alan's procedure and Terry's drawing.

```
?TO RECT
>REPEAT 2 [FD 20 RT 90 FD 40 RT 90]
>END
?TO FLOWER
>REPEAT 8 [RT 45 RECT]
>END
```



You can use any procedure Terry knows as part of a new procedure. But, Terry will only remember your procedures as long as your APPLE computer is left on. If you must turn your computer off, save your procedure on your file disk.

## Write with Terry

1. Lee wrote this procedure

```
?TO SILLY
>FD 30
>BOX
>RICE
>ME
>END
```

Which three procedures did she use in SILLY?

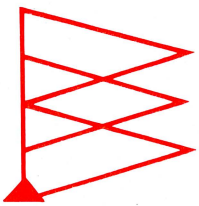
_____

2. Kerry wrote a procedure named LION. Then, she turned off the computer. The next day, she typed the command LION and Terry responded, I DON'T KNOW HOW TO LION. Why did Terry forget the procedure named LION?

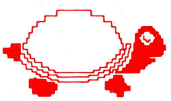
_____

## Terry's Drawings

Walt taught Terry to draw a procedure named NICE. First, he used a procedure named TRI to teach Terry to draw a triangle. Can you write a procedure to draw the design on the next page?



## Draw with Terry

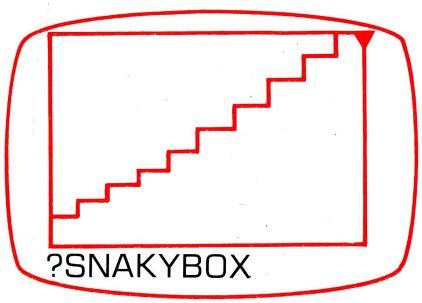


**1.** Read the directions below. Then draw Terry's picture on the sample screen.

```
?TO NEWBOX
>REPEAT 4 [FD 30 RT 90]
>END
?TO FUN
>REPEAT 8 [NEWBOX LT 45]
>END
```

?FUN

**2.** Look at the turtle drawing below. Write the missing lines to teach Terry to draw this design.

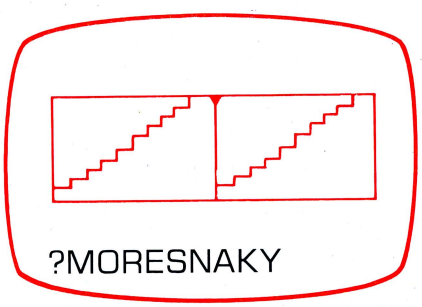


?SNAKYBOX

```
?TO SNAKY
>REPEAT 10 [FD 10 RT 90 FD 10 LT 90]
```

```
?TO SNAKYBOX
```

**3.** Write the missing lines to teach Terry to draw this procedure named MORESNAKY. (Hint: Terry knows how to SNAKYBOX.)



?MORESNAKY

```
?TO MORESNAKY
>SNAKYBOX
```

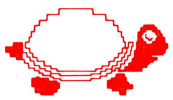
```
>END
```

**4.** Write a procedure to teach Terry to draw a design with lines and squares.

# CHAPTER 5: Circles and Colors

## LESSON 1

### Read with Terry



Hank knows that Terry can move FORWARD and BACK. Terry can also turn LEFT and RIGHT. How can he use these commands to make Terry draw a circle?

Hank found out that a circle has 360 degrees. This hint let Hank know that he would have to teach Terry to go FORWARD some amount and turn some amount until the turtle turned a total of 360 degrees. Hank typed this procedure to teach Terry to draw a circle.

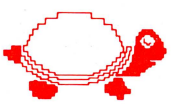
```
?TO CIRCLE
>REPEAT 360 [FD 1 RT 1]
>END
```

Becky wrote a different procedure to draw a circle. She typed

```
?TO CIRCLE
>REPEAT 180 [FD 1 LT 2]
>END
```

Terry drew a circle with Becky's procedure. The turtle turned 2 degrees at a time. Terry did this 180 times, so the turtle turned 360 degress in all.

### Write with Terry



1. How many degrees must Terry turn to draw a circle?

   _____

2. Circle the instructions which will teach Terry to draw the larger circle.
   a. REPEAT 90 [FD 4 RT 4]
   b. REPEAT 90 [FD 1 LT 4]
3. Fill in the missing number to teach Terry to draw a circle.

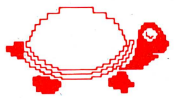
   a. REPEAT 10 [FD 4 LT _____ ]

   b. REPEAT 15 [FD 3 RT _____ ]

   c. REPEAT 20 [FD 3 LT _____ ]

   d. REPEAT 45 [FD 6 RT _____ ]

## Draw with Terry



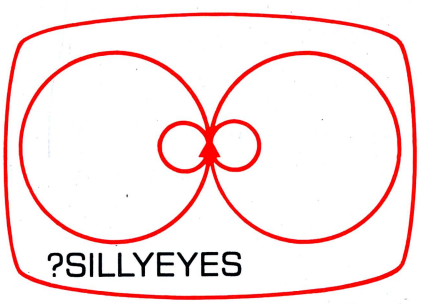
**1.** Read the directions below. Then draw Terry's picture on the sample screen.

```
?TO CIRCLELT
>REPEAT 180 [FD 2 LT 2]
>END
?TO CIRCLERT
>REPEAT 180 [FD 2 RT 2]
>END
?TO LOOP
>CIRCLELT
>CIRCLERT
>END
```

?LOOP

---

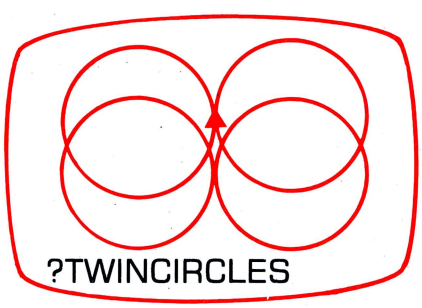
**2.** Look at the turtle drawing below. Write the missing lines to teach Terry to draw this shape. (Hint: Terry knows how to LOOP.)




```
?TO PUPILLT
>REPEAT 60 [FD 1 LT 6]
>END
?TO PUPILRT
>REPEAT 60 [FD 1 RT 6]
>END
?TO SILLYEYES
_____
_____
>LOOP
_____
```

---

**3.** Write the missing lines to teach Terry to draw this design. (Hint: Terry knows how to LOOP.)




```
?TO TWINCIRCLES
_____
_____
>FD 50
>PD
_____
>END
```

---

**4.** Write a procedure to teach Terry to draw a snowman. Use a large circle for the body and a smaller circle for the head. Give the snowman a hat.

_____

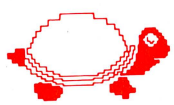
## Read with Terry

Yvette wrote a procedure to teach Terry to draw an Olympic flag on her screen. The flag's pole disappeared behind the commands at the bottom of the screen. Yvette solved this problem by typing CTRL-L. CTRL-L is the abbreviation for the command FULLSCREEN. Now, Yvette could see the entire drawing at one time. CTRL-L or FULLSCREEN removes the four lines for typing commands from the bottom of the screen. The entire screen is used for a turtle drawing.

When Yvette was ready to use the normal turtle screen, she typed CTRL-S. CTRL-S is the abbreviation for the command SPLITSCREEN. CTRL-S or SPLITSCREEN is the normal turtle screen. Terry can draw on the upper part of the screen. The bottom four lines are saved for typing commands for Terry.

Sometimes, Yvette writes a very long set of commands for Terry. When she does this, she types CTRL-T or TEXTSCREEN. This command allows her to use the entire screen for writing commands and procedures. The drawing will not be visible until she types CTRL-L or CTRL-S.

## Write with Terry



1. Write the abbreviation for each word.

   SPLITSCREEN _____ TEXTSCREEN _____

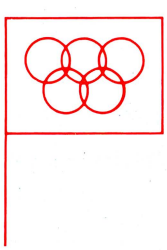
   FULLSCREEN _____

2. Which command must you type to see Terry's drawing if you are writing on the TEXTSCREEN?

   _____

## Terry's Drawings

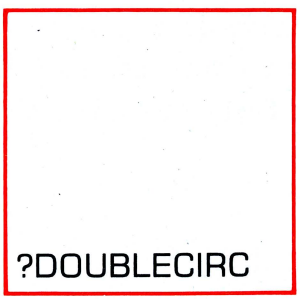
Here is Yvette's design of an Olympic flag on the FULLSCREEN. Can you write a procedure to make this design?



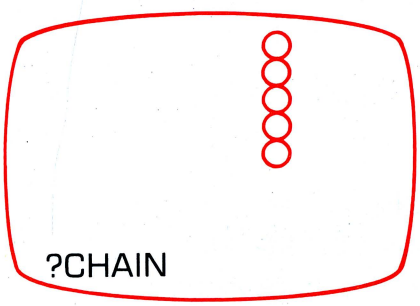
## Draw with Terry

**1.** Read the directions below. Then draw Terry's picture on the sample screen.

```
?TO DOUBLECIRC
>LOOP
>RT 180
>PU
>FD 50
>PD
>FULLSCREEN
>LOOP
>END
```

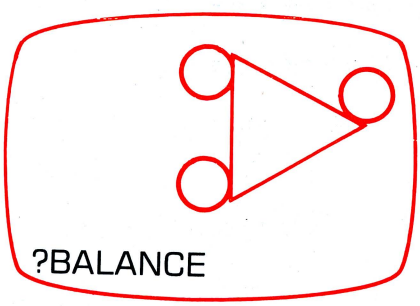



**2.** Look at the turtle drawing below. Write the missing lines to teach Terry to make this design.




```
?TO SMCIRC
>REPEAT 60 [FD 1 LT 6]
>END
?TO CHAIN
_____
>FD 100
_____
>REPEAT 5 [SMCIRC PU BK 20 PD]
_____
>END
```

**3.** Write the missing lines to teach Terry to draw this design. (Hint: Terry knows how to SMCIRC.)



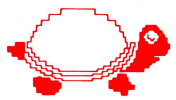

```
?TO TRI
>REPEAT 3 [FD 50 RT 120]
>END
?TO BALANCE
_____
_____
>FD 50
_____
>RT 120
>FD 50
_____
>END
```

**4.** Write a procedure to teach Terry to draw a truck.

_____

# LESSON 3

## Read with Terry



Would you like to see Terry draw your designs in color? It's easy if you have a color monitor attached to your APPLE. Here's how Ron taught Terry to draw a circle on a green background.

```
?TO CIRC
>REPEAT 360 [FD 1 RT 1]
>END
```

This is Ron's procedure for a circle. He is giving Terry instructions to move forward one step, turn right one degree, and repeat these instructions 360 times.

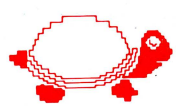
```
?TO GREENBACK
>SETBG 2
>CIRC
>END
```

The command SETBG tells Terry to SET the color of the BackGround to color 2, which is green. The CIRC command tells Terry to draw a circle on the green background.

Here are some other background colors for your APPLE:

| | |
|---|---|
| SETBG 0 - black background | SETBG 3 - violet background |
| SETBG 1 - white background | SETBG 4 - orange background |
| SETBG 2 - green background | SETBG 5 - blue background |

## Write with Terry



1. On how many different color backgrounds can Terry draw?

   _____

2. What is the abbreviation for set background color?

   _____

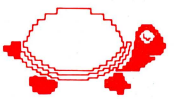
3. Tracy wants to draw a box on a blue background. What is the command to set a blue background?

   _____

4. Paul typed the command SETBG 4. On what color background did Terry draw?

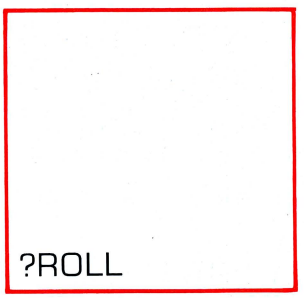
   _____

## Draw with Terry

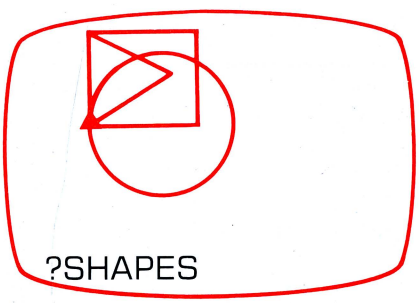


**1.** Read the directions below. Then draw Terry's picture on the sample screen.

```
?TO ROLL
>SETBG 4
>RT 90
>REPEAT 10 [SMCIRC FD 10]
>HT
>END
```

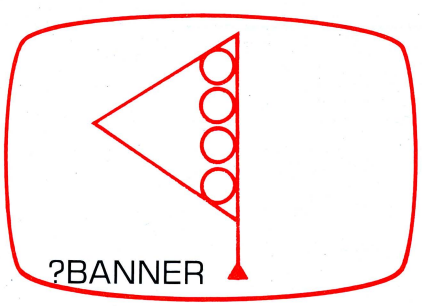



**2.** Look at the turtle drawing below. Write the missing lines to teach Terry to draw this shape. (Hint: Terry knows how to CIRCLERT.)




```
?TO SHAPES
>SETBG 5
_____
_____
_____
>END
```

**3.** Write the missing lines to teach Terry to draw this design. (Hint: Terry knows how to SMCIRC.)



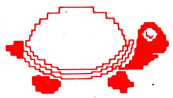

```
?TO BANNER
>SETBG 3
_____
_____
_____
_____
_____
```

**4.** Write a procedure to teach Terry to draw two different banners. Draw the banners on a violet background.

# CHAPTER 6: Variables

## LESSON 1

### Read with Terry

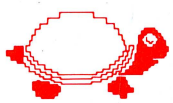


Josh taught the turtle to draw three different-sized squares. He named his three procedures TO BOX1, TO BOX2, and TO BOX3. Beth also taught the turtle to draw three different-sized squares. She did this with one procedure named TO BOX :SIZE. Beth used a **variable** name in her procedure:

```
?TO BOX :SIZE
>REPEAT 4 [FD :SIZE RT 90]
>END
```

**Variables** are letters or words that tell the turtle you will give it more information later. (Numbers are not used as variables.) The **variable** name in Beth's procedure is :SIZE. Variables are always written after dots (:). Do not put any spaces between the dots and the name.

### Write with Terry



1. What do you call words or letters written right after dots (:)?

   _____

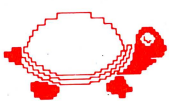
2. Bob wrote a procedure named TO LINE :LONG. What is the name of the variable in his procedure?

   _____

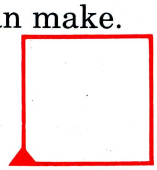
3. Read the procedure, and write what is missing.

   ```
   ?TO BOX :S
   >REPEAT 4 [FD :_____ RT 90]
   >END
   ```

### Terry's Drawings

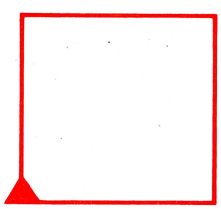


Beth knew that she had to tell Terry how long to draw each side of the square every time she ran the procedure. So she typed the name of the procedure and a number for the variable, :SIZE. Here are some squares Beth taught Terry to draw. Using Beth's procedure, see how many different-size squares you can make.



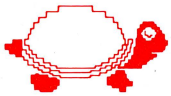
BOX 50

BOX 10



BOX 100

## Draw with Terry



**1.** Read the procedure below. Draw the turtle drawing on the screen.

```
?TO SQUARE :Y
>REPEAT 4 [FD :Y RT 90]
>END
?TO MANYSQUARES
>SQUARE 30
>SQUARE 50
>SQUARE 70
>END
```

?MANYSQUARES

**2.** Read the procedure below. Draw the turtle drawing on the screen.

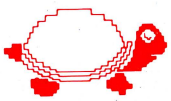
```
?TO TRI :X
>REPEAT 3 [FD :X RT 120]
>END
?TO PRETTY
>TRI 100
>TRI 75
>TRI 50
>END
```

?PRETTY

**3.** Teach Terry to make a design with different-size squares and triangles. Draw your picture below and write the procedure on the lines.

# LESSON 2

## Read with Terry



You know that you can teach the turtle to draw many different squares from one procedure. This is the way Terry reads Beth's procedure.

Terry reads the name of the procedure as To Box dots Size.

Terry opens a memory box in the computer and labels it SIZE.

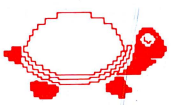
Terry waits for more information.

Beth types BOX 30. Terry puts the number 30 in the memory box named SIZE.

Terry uses the number in the memory box to replace the word SIZE in the procedure.

Terry draws a square 30 units long on each side.

## Write with Terry



**1.** Circle the variable names which are written correctly.

a. :AGE
b. : SIDE
c. :3
d. :VPXZ
e. :2G
f. : BIG

**2.** Jack wrote a procedure named TO BOX :LONG. He wants Terry to draw a box 100 units long. Circle the command he should type.

a. BOX :100
b. BOX LONG
c. BOX 100

**3.** Write TRUE or FALSE after each sentence.

a. Variable names are words or letters. _____
b. You read the variable name :X as "dots X". _____
c. Variable names can begin with a number. _____
d. A variable stands for a number. _____

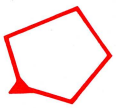
## Terry's Drawings

Fred taught Terry to draw pentagons. He used the procedure

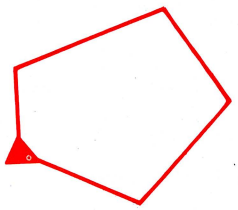
```
?TO PENTA :S
>REPEAT 5 [FD :S RT 72]
>END
```

Here are some pentagons Terry drew. See how many pentagons you can tell Terry to draw.

PENTA 30

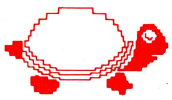


PENTA 50

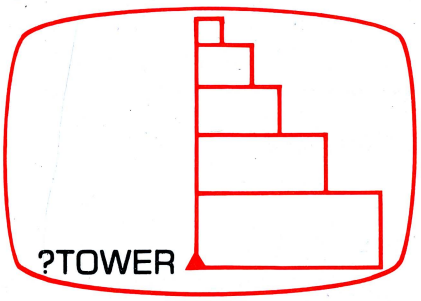


PENTA 90

## Draw with Terry

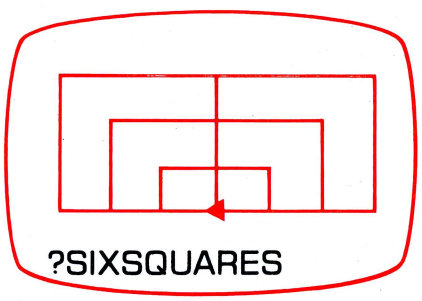


**1.** Look at the turtle drawing below. Write the missing lines to teach Terry to draw this figure. (Hint: Terry knows how to SQUARE.)




```
?TO TOWER
>FD 100
>SQUARE 10
>BK 20
_____
_____
>SQUARE 30
_____
_____
_____
>SQUARE 50
>END
```

**2.** Look at the turtle drawing below. Write the missing lines to teach Terry to draw this figure.

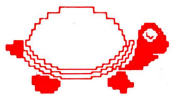



```
?TO SIXSQUARES
>SQUARE 50
>SQUARE 30
_____
>LEFT 90
>SQUARE 10
_____
_____
_____
```

**3.** Use the BOX and TRI procedures to teach Terry to draw different-size houses.

# LESSON 3

## Read with Terry



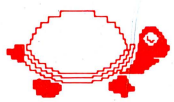
You can use more than one variable name in a procedure. Ken wrote a procedure to teach the turtle to draw many different rectangles. He used two variables: one for the length and one for the width. Here is Ken's procedure for rectangles:

```
?TO RECT :L :W
>REPEAT 2 [FD :L RT 90 FD :W RT 90]
>END
```

When Ken runs this procedure, he must remember to tell Terry two numbers. One number is for the length, and the other is for the width.

You must use different words or letters for each variable in a procedure. Remember to type TWO numbers if you use two different variables.

## Write with Terry



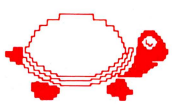
1. Circle the correct titles for procedures with more than one variable.

   a. TO SHAPE SIDE :ANGLE
   b. TO MAZE :LENGTH :TURN
   c. TO PIX :XYZ PQR
   d. TO SHAPE :SIDE :SIDE

2. Write TRUE or FALSE after each sentence.
   a. You may name a procedure with two variables TO QUAD :L :L. _____
   b. One variable in a procedure may be named :234. _____
   c. You read the title TO ABC :M :P as "To ABC dots M dots P." _____
   d. A procedure may have more than one variable. _____
3. How many variables will the turtle look for in a procedure named TO SNAKY :A :B :C?

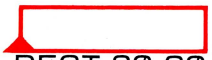
   _____

## Terry's Drawings



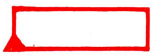
Ken knew he had to type two numbers after the name RECT to teach Terry to draw different rectangles. At the top of the next page are some rectangles Ken taught Terry to draw. How many rectangles can you teach Terry to draw?

_____

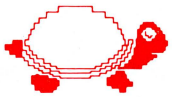

RECT 30 80

RECT 50 20

RECT 80 30

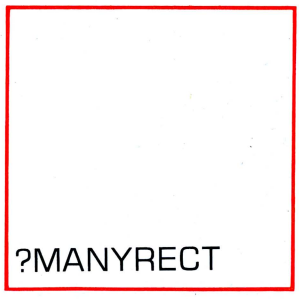

RECT 20 50

## Draw with Terry

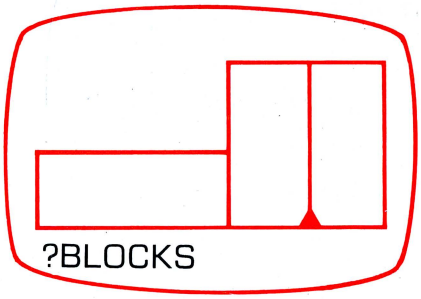


**1.** Read the procedure. Draw the turtle drawing on the screen.

```
?TO MANYRECT
>RECT 30 100
>RECT 50 100
>RECT 70 100
>END
```

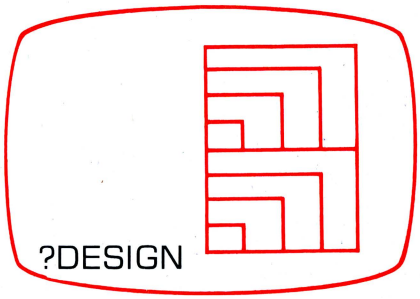

?MANYRECT

**2.** Look at the turtle drawing below. Write the missing lines to teach Terry to draw this figure. (Hint: Terry knows how to RECT.)


?BLOCKS

```
?TO BLOCKS
>LT 90
>RECT 90 30
>RT 90
_____
>RT 90
>FD 30
_____
_____
>END
```

**3.** Look at the turtle drawing below. Write the missing lines to teach Terry to draw this figure. (Hint: Terry is hiding some of the work. Press CTRL-L to see the whole picture!)

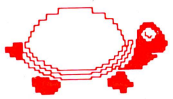

?DESIGN

```
?TO DESIGN
>RECT 80 100
_____
>RECT 40 60
>RECT 20 40
>BK 80
>RECT 80 100
>RECT 60 80
_____
_____
_____
```

# CHAPTER 7: Using Recursions

## LESSON 1

### Read with Terry



Greta wrote a procedure to teach Terry to draw circles of different sizes. Here is her procedure.

```
?TO CIRCLE :SIZE
>REPEAT 36 [FD :SIZE RT 10]
>END
```

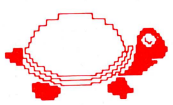
Greta used this procedure to make a design called MINE:

```
?TO MINE
>CIRCLE 2
>RT 45
>CIRCLE 4
>RT 45
>MINE
>END
```

Terry began to draw CIRCLE 2. Then the turtle turned RT 45 degrees and drew CIRCLE 4. Terry continued to follow the instructions by turning RT 45. Then Terry saw the command MINE. This command told Terry to draw the procedure named MINE. It made Terry repeat the MINE procedure over and over.

A procedure like MINE is called a **recursive** procedure. It uses itself as part of the procedure. These procedures make the turtle repeat itself until it is directed to stop. You can stop Terry by typing CTRL-G.

### Write with Terry



**1.** How many times will Terry repeat a recursive procedure?

_____

**2.** How can you tell Terry to stop a recursive procedure?

_____

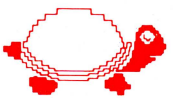
**3.** Write the missing line to make this a recursive procedure.

```
?TO HARRY
>RT 45
>BOX 30
```

_____

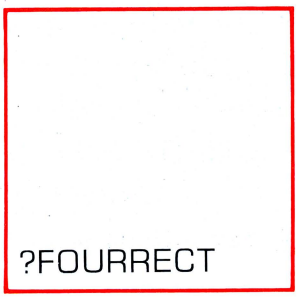
```
>END
```

## Draw with Terry

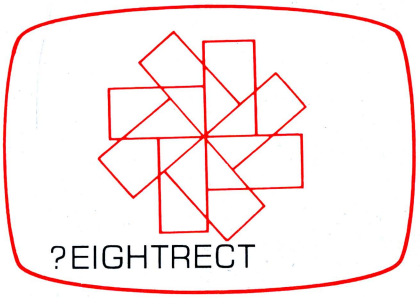


**1.** Read the directions below. Then draw Terry's picture on the sample screen.

```
?TO RECT :B :L
>REPEAT 2 [FD :B RT 90 FD :L
  RT 90]
>END
?TO FOURRECT
>LT 90
>RECT 50 20
>FOURRECT
>END
```

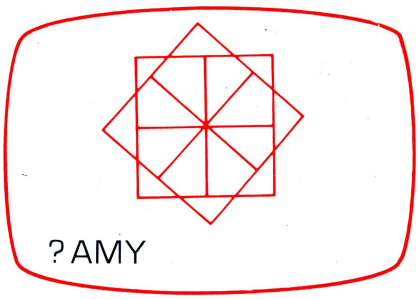



**2.** Look at the turtle drawing below. Write the missing lines to teach Terry to draw this shape. (Hint: Terry knows how to RECT :B :L.)




```
?TO EIGHTRECT
_____
>RECT 40 25
_____
>END
```

**3.** Write the missing lines to teach Terry to draw this design.



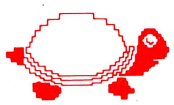

```
?TO BOX :S
_____
>END
?TO AMY
>LT 45
_____
>RT 90
_____
>END
```

**4.** Write a procedure to make a recursive design from any two shapes.

_____

# LESSON 2

## Read with Terry



Mike thought about the different polygons he taught Terry to draw. He made a list of each shape. Next to the name of the shape, Mike wrote the number of angles in the shape and the number of degrees in each angle. Mike made an interesting discovery about polygons by studying the list. Look at Mike's list and see if you can make a discovery about polygons.

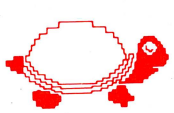
| SHAPE | ANGLES | DEGREES | TOTAL |
|---|---|---|---|
| triangle | 3 | 120 | 360 |
| rectangle | 4 | 90 | 360 |
| pentagon | 5 | 72 | 360 |

Mike discovered Terry had to turn a total of 360 degrees for each shape. He also realized that for each of these polygons, Terry began and ended the drawing in the same place. This is called **THE TOTAL TURTLE TRIP THEOREM.** The Total Turtle Trip Theorem means that Terry will turn a total of 360 degrees to start and end in the same position.

## Write with Terry

1. How many degrees must Terry turn to draw a hexagon? (Hint: A hexagon has six angles.) _____
2. How many degrees must Terry turn to draw a decagon? (Hint: A decagon has ten angles.) _____
3. Terry drew a nonagon. The turtle turned 40 degrees each time. How many angles are in a nonagon? _____

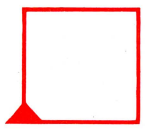
## Terry's Drawings



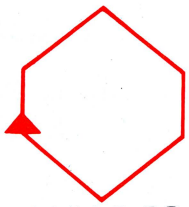
Jane wrote a procedure to teach Terry to draw any polygon. (Hint: 360/TIMES means 360 divided by the value of TIMES.)

```
?TO ANY :TIMES :STEPS
>REPEAT :TIMES [FD :STEPS RT 360/:TIMES]
>END
```

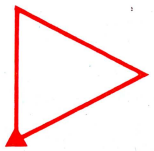
Look at the shapes Jane taught Terry to draw. How many shapes can you make with her procedure?



ANY 4 25

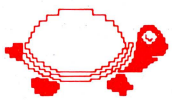


ANY 6 60



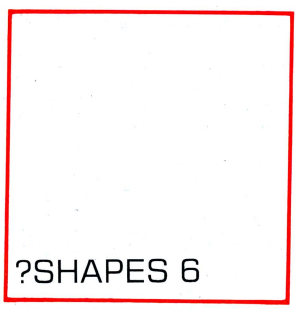
ANY 3 50

## Draw with Terry



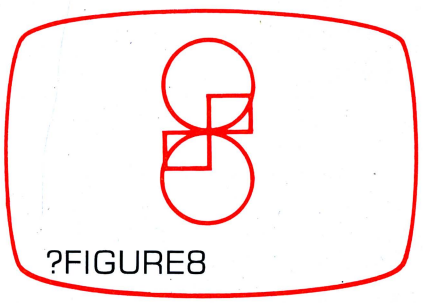
**1.** Read the procedure below. Then draw Terry's picture on the sample screen.

```
?TO SHAPES :ANY
>REPEAT :ANY [FD 35 LT 360/:ANY]
>SHAPES :ANY
>END
```



?SHAPES 6

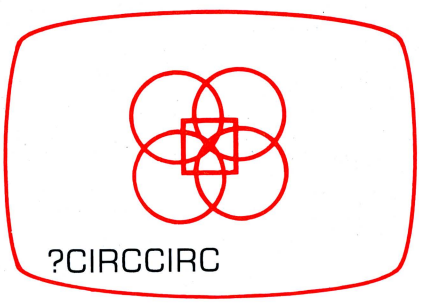
**2.** Look at the turtle drawing below. Write the missing lines to teach Terry to draw this shape.



?FIGURE8

```
?TO FIGURE8
>FULLSCREEN
_____
>RT 90
>REPEAT 360 [FD 1 RT 1]
_____
_____

>END
```

**3.** Write the missing lines to teach Terry to draw this shape.

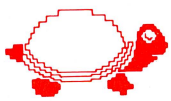


?CIRCCIRC

```
?TO CIRC
>REPEAT 180 [FD 2 RT 2]
>END
?TO MOVE
>FD 50 RT 90
>END
?TO CIRCCIRC
_____
_____
_____
>END
```

**4.** Teach Terry to draw a recursive design. Use at least three procedures in your recursive procedure.

## Read with Terry



You have taught Terry to follow recursive procedures to draw beautiful designs. Some of these designs may have been drawn on colored backgrounds. Have you wished that the turtle could actually draw in colors? Terry can! Here is Cara's procedure for a colorful design.

```
?TO COLORFUL
>SETPC 4
>REPEAT 4 [FD 50 RT 90]
>RT 45
>SETPC 5
>REPEAT 5 [FD 50 RT 120]
>COLORFUL
>END
```

SETPC is an abbreviation for the command SET PENCOLOR. The command SETPC 4 tells Terry to draw with an orange pen. The command SETPC 5 tells Terry to draw with a blue pen. This recursive procedure teaches Terry to draw a design with orange squares and blue triangles.

Here is a list of Terry's pencolors.

| | |
|---|---|
| SETPC 0 - black | SETPC 3 - violet |
| SETPC 1 - white | SETPC 4 - orange |
| SETPC 2 - green | SETPC 5 - blue |

Some pencolors will not draw on certain background colors. The orange pen will not be visible on a green background, and the green pen will not be visible on an orange background. Two more colors that will not work together are blue and violet.

## Write with Terry

1. What is the abbreviation for SET PENCOLOR?

   _____

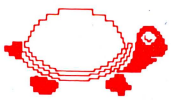
2. With how many colors can Terry draw?

   _____

3. Which pencolor will not be visible on a blue background?

   _____

## Draw with Terry

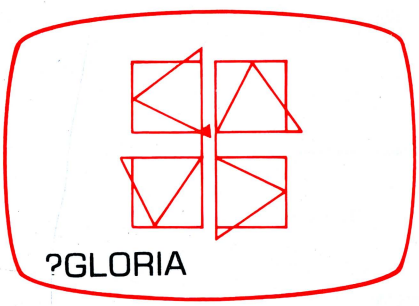


**1.** Read the procedure below. Then draw Terry's design on the sample screen.

```
?TO PRETTYPIC
>LT 90
>REPEAT 3 [FD 50 RT 120]
>LT 90
>REPEAT 6 [FD 50 RT 60]
>PRETTYPIC
>END
```

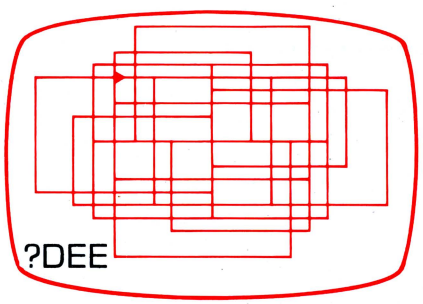
?PRETTYPIC

**2.** Look at the turtle drawing below. Then write the missing lines to teach Terry to draw this design.




```
?TO MOBILE
>RT 90 FD 10
>END
?TO GLORIA
>REPEAT 4 [FD 50 LT 90]
_____
>REPEAT 3 [FD 60 LT 120]
_____
_____
```

**3.** Write the missing lines to teach Terry to draw this shape. (Hint: Terry knows how to BOX :S and MOVE.)




```
?TO DEE
>SETPC 1
>BOX 60
>MOVE
>BOX 70
_____
_____
_____
>BOX 90
_____
>RT 90
_____
>END
```

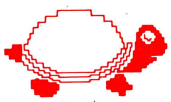
**4.** Write a recursive procedure to teach Terry to make a design with large and small octagons in two different colors.

_____

# CHAPTER 8: Turtle Stars and Spinsquares

## LESSON 1

### Read with Terry



Carlos decided to teach Terry to make a series of stars on his monitor. He discovered that the turtle had to turn 144 degrees to make a perfect five-pointed star. Here is his procedure.

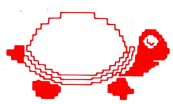
```
?TO STAR :SIDE
>REPEAT 5 [FD :SIDE RT 144]
>END
```

Peggy discovered that she could use one procedure to create many types of stars. Here is her procedure.

```
?TO MANYSTARS :SIDES :ANGLES
>FD :SIDES RT :ANGLES
>MANYSTARS :SIDES :ANGLES
>END
```

Not all inputs will make stars with Peggy's procedure. She experimented and found many that did work.

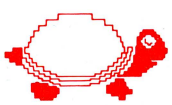
### Write with Terry



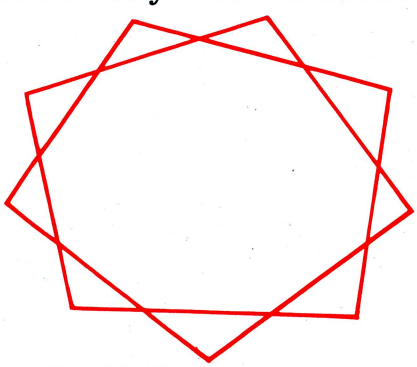
1. The STAR :SIDE procedure makes Terry turn 144 degrees 5 times. How many degrees does Terry turn in all? _____
2. Peggy used the numbers 30 80 to teach Terry to draw a star with 9 points. How many degrees did Terry turn in all? ____
3. Which of the two procedures above contains a recursion?

_____

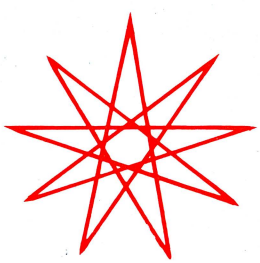
### Terry's Drawings



Rhonda used Peggy's procedure to make these stars. Which numbers can you use to make other stars?



MANYSTARS 50 80



MANYSTARS 50 160

## Draw with Terry

**1.** Read the procedure below. Then draw Terry's picture on the sample screen.

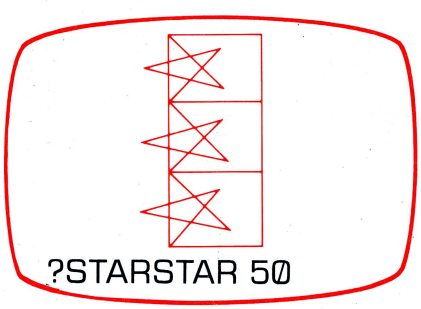
```
?TO STAR :SIDE
>REPEAT 5 [FD :SIDE RT 144]
>END
?TO STARSQUARE
>STAR 50
>PU FD 50 LT 90 PD
>STARSQUARE
>END
```

?STARSQUARE

**2.** Look at the turtle drawing below. Then write the missing lines to teach Terry to draw this design. (Hint: Terry knows how to STAR :SIDE.)

```
?TO STARFIELDS :SIDE
_____
>PU RT 45 FD :SIDE PD
_____
>END
```

**3.** Write the missing lines to teach Terry to draw this design. (Hint: Terry knows how to STAR :SIDE.)

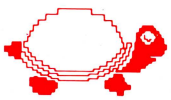



```
?TO STARSTAR :SIDE
>FULLSCREEN
>HT
>PU FD 50 PD
>REPEAT 4 [FD :SIDE RT 90]
_____
>BK :SIDE
_____
_____
_____
_____
_____
>END
```

**4.** Teach Terry to fill your screen with stars.

_____

## Read with Terry



One interesting pattern that you can teach Terry to draw is called a **spinsquare**. Spinsquares are any shape that Terry "spins" around a central point. Here is Victor's procedure for a spinsquare.

```
?TO SPINSQUARE
>REPEAT 4 [FD 50 RT 90]
>RT 45
>SPINSQUARE
>END
```

While Victor was pleased with the spinsquare Terry drew, he wanted a procedure to allow the turtle to use any shape in a spinsquare design. Victor experimented and found this procedure worked.

```
?TO MANYSPIN :LENGTH :SIDES :DEGREES
>RT :DEGREES
>REPEAT :SIDES [FD :LENGTH RT 360/:SIDES]
>MANYSPIN :LENGTH :SIDES :DEGREES
>END
```

The title of this procedure tells Terry to look for three inputs: the LENGTH of each side, the number of SIDES in the shape, and the number of DEGREES to turn before making the next shape. This procedure allowed Victor to create many different designs from one procedure.

## Write with Terry

1. Why are these procedures called spinsquares?

   _____

2. What does the variable name DEGREES stand for in the MANYSPIN procedure?

   _____

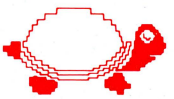
3. What does SIDES stand for in this procedure?

   _____

4. What does LENGTH stand for in this procedure?

   _____

## Draw with Terry

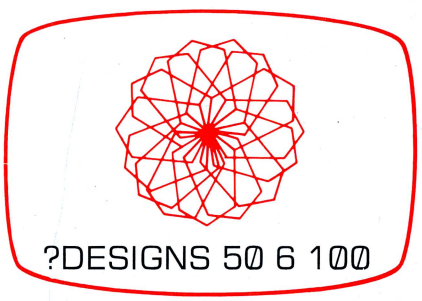


**1.** Read the procedure below. Then draw Terry's design on the sample screen.

```
?TO SPINSQUARES :SIDE
>REPEAT 4 [FD :SIDE RT 90]
>RT 45
>REPEAT 3 [FD :SIDE RT 120]
>RT 45
>SPINSQUARES :SIDE
>END
```

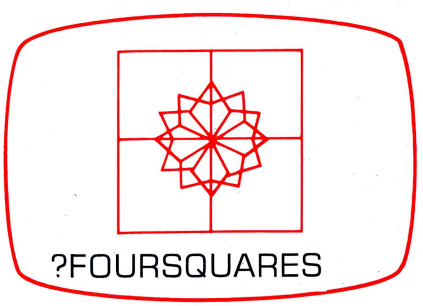
?SPINSQUARES 75

**2.** Look at the turtle drawing below. Then write the missing lines to teach Terry to draw this design.




```
?TO DESIGNS :LONG :SIDES :DEG
_____
>REPEAT :SIDES [FD :LONG RT 360/
  :SIDES]
>FULLSCREEN
_____
>END
```

**3.** Write the missing lines to teach Terry to draw this shape. (Hint: Terry knows how to DESIGNS.)

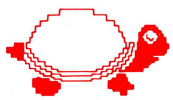



```
?TO FOURSQUARES
>REPEAT 4 [FD 50 RT 90]
>LT 90
_____
_____
_____
_____
_____
>DESIGNS 30 3 30
>END
```

**4.** Use the DESIGNS procedure to teach Terry to draw a design from spinning pentagons.

# LESSON 3

## Read with Terry



There is an easy way to teach Terry to draw a recursive design and then stop at a certain point. Look at the procedure Donna wrote.

```
?TO STEPBOXES :SIZE
>IF :SIZE > 100 [STOP]
>SQUARE :SIZE
>STEPBOXES :SIZE + 10
>END
```

The first line of the procedure tells Terry to check the SIZE of the square. If it is greater than ( > ) 100, Terry will STOP drawing. If the size is not greater than 100, Terry will draw the square. Then Terry will add 10 to the size of the square, and repeat the procedure. Terry will continue to add 10 and draw new squares until the size is greater than 100. Then the turtle will stop the procedure.

Here is another way to write Donna's procedure.

```
?TO STEPSQUARES :SIZE
>IF :SIZE < 10 [STOP]
>SQUARE :SIZE
>STEPSQUARES :SIZE - 3
>END
```

In this procedure, Terry checks to see if the size is less than ( < ) 10. If it is, Terry stops the procedure. If the size is not less than 10, Terry draws the square, subtracts 3 from the size, and continues to draw until the size is less than 10.

## Write with Terry

1. What symbol means "is greater than"? _____
2. Larry wrote the command STEPBOXES 10. How many boxes did Terry draw?

   _____

3. Walter wrote the command STEPSQUARES 12. How many squares did Terry draw?

   _____

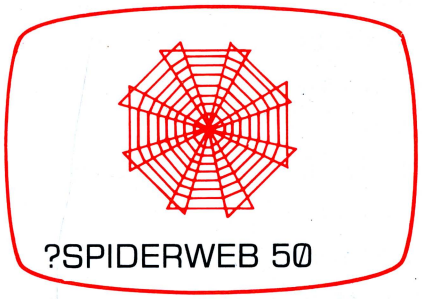
## Draw with Terry

**1.** Read the procedure below. Then draw Terry's picture on the sample screen.

```
?TO MANYOCT :SIDE
>FULLSCREEN
>IF :SIDE < 20 [STOP]
>REPEAT 8 [FD :SIDE RT 45]
>MANYOCT :SIDE - 10
>END
```

?MANYOCT 50

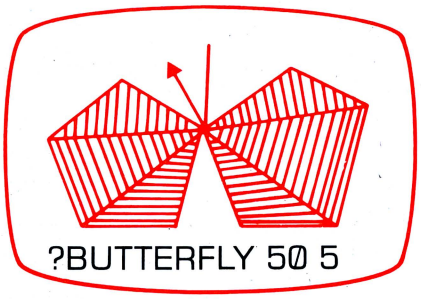
**2.** Look at the turtle drawing below. Then write the missing lines to teach Terry to draw this design. (Hint: Do not let Terry make a triangle with a side > 100.)



?SPIDERWEB 50

```
?TO GROWINGTRI :SIDES
_____
_____
>GROWINGTRI :SIDES + 5
>END
?TO SPIDERWEB :SIDES
>SETBG 1
>SETPC 0
>FULLSCREEN
_____
>END
```

**3.** Write the missing lines to teach Terry to draw this design. (Hint: Don't allow Terry to make a side less than 1.)



?BUTTERFLY 50 5

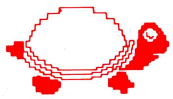
```
?TO SMALLSPIN :SIDES :ANGLES
_____
>REPEAT :ANGLES [FD :SIDES RT 360 /
  :ANGLES]
>SMALLSPIN :SIDES - 2 :ANGLES
>END
?TO BUTTERFLY :SIDES :ANGLES
_____
>SMALLSPIN :SIDES :ANGLES
>RT 135
_____
>LT 180 FD 50 BK 50 LT 20 FD 50
_____
```

**4.** Use the SMALLSPIN procedure to teach Terry to make a design shrinking squares and shrinking octagons.

# CHAPTER 9: Recursions and Spirals

## LESSON 1

### Read with Terry

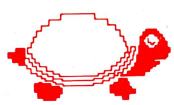


You have taught Terry to draw a series of shapes by increasing and decreasing the size of your first shape. You can also teach Terry to draw spiral designs by increasing or decreasing the size of the side and the size of the angles. Spirals are designs that use recursions to teach Terry to draw open designs over and over again. A spiral design is never closed. Here is Peter's procedure for drawing spiral designs.

```
?TO SPIRAL :SIDE :ANGLE
>IF :SIDE > 100 [STOP]
>FD :SIDE
>RT :ANGLE
>SPIRAL :SIDE + 1 :ANGLE
>END
```

The title line tells Terry that you will give the turtle two bits of information: the size of the first side, and the size of the angle. The second line tests the size of the side. If the size is greater than 100, Terry STOPs. If the size is not greater than 100, Terry continues the design. The last line of the procedure is the recursive line. This line tells Terry to increase the size of the side by 1, then to repeat the entire design until the size of the side is greater than 100.

### Write with Terry



1. How many bits of information must the user give Terry in the SPIRAL procedure? _____

2. Dottie used Peter's procedure and directed Terry to start the design with a side of 150 and an angle of 90 degrees. What shape did Terry draw?

   _____

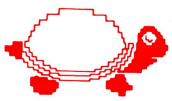
3. Dave ran Peter's procedure by typing SPIRAL 45. What kind of message did Terry send him?

   _____

4. Fran typed SPIRAL 98 90. How many sides did Terry draw before the turtle STOPped?

   _____

## Draw with Terry



**1.** Read the procedure below. Then draw Terry's picture on the sample screen.

```
?TO TWOSPIRAL
>FULLSCREEN
>SPIRAL 50 90
>FD 100 LT 90
>SPIRAL 50 90
>END
```

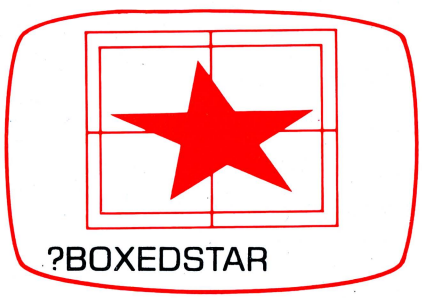
?TWOSPIRAL

**2.** Look at the turtle drawing below. Then write the missing lines to teach Terry to draw this design. (Hint: Terry knows how to SPIRAL.)

?EXPLODINGSTAR

```
?TO EXPLODINGSTAR
>PU FD 50
_____
>SPIRAL 10 190
>RT 80
_____
_____
>FD 100
_____
>FD 200
_____
_____
_____
_____
>END
```

**3.** Write the missing lines to teach Terry to draw this design.



?BOXEDSTAR

```
?TO BOXEDSTAR
>REPEAT 4 [SQUARE 75 RT 90]
_____
_____
>FULLSCREEN
_____
>END
```

**4.** Teach Terry to draw a design with two different spirals.

_____

## Read with Terry

Another way to write a procedure to teach Terry to draw spiral designs is to allow the user to decide three things: the size of the first side, the size of the angle, and the number by which the side is increased or decreased. Here is Monique's procedure to teach Terry to draw decreasing spirals and Jacob's procedure to teach Terry to draw increasing spirals.

Monique's Procedure

```
?TO SMSPIRAL :SIDE :ANGLE :DEC
>IF :SIDE < 1 [STOP]
>FD :SIDE
>RT :ANGLE
>SMSPIRAL :SIDE - :DEC :ANGLE
 :DEC
>END
```

Jacob's Procedure

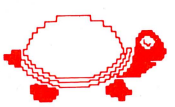
```
?TO BIGSPIRAL :SIDE :ANGLE :INC
>IF :SIDE > 100 [STOP]
>FD :SIDE
>RT :ANGLE
>BIGSPIRAL :SIDE + :INC :ANGLE :INC
>END
```

Both procedures let you decide the size of the side, the angle, and the amount to decrease or increase the side when you run the procedure. Terry is directed to STOP the procedure if the length of the side is less than 1 in Monique's procedure, and greater than 100 in Jacob's.

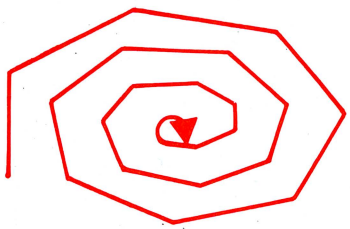
## Write with Terry

1. How many bits of information will you have to give Terry when you run Jacob's procedure? _____
2. Arnold typed SMSPIRAL 50 90 5. What was the length of the first side Terry drew? _____
3. Yolanda typed BIGSPIRAL 10 70 2. By how many units did Terry increase the length of the side each time? _____
4. Doug typed SMSPIRAL 50 45 10. How many sides did Terry draw before the procedure was stopped? _____

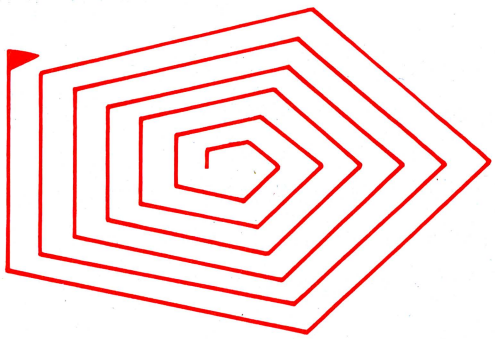
## Terry's Drawings



Samantha made the designs at the top of the next page with the SMSPIRAL and BIGSPIRAL procedures. How many different designs can you teach Terry to draw?



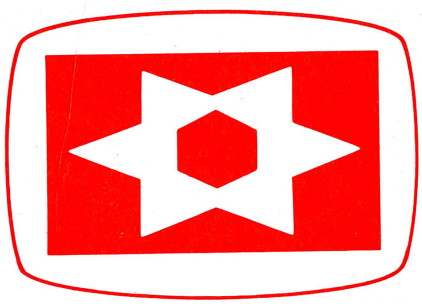
SMSPIRAL 50 50 2



BIGSPIRAL 10 72 3

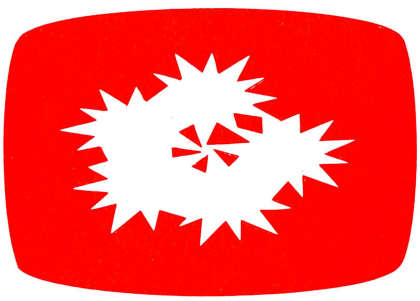
## Draw with Terry

**1.** Look at the turtle drawing below. Then write the missing lines to teach Terry to draw this design. (Hint: Terry knows how to SMSPIRAL.)



```
?TO SPISTAR
>SETBG 1 SETPC 5
>REPEAT 6 [SMSPIRAL 50 120 3 RT 60]
>PU
_____
_____
_____
_____
_____
>HT
>END
```

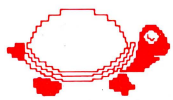
**2.** Write the missing lines to teach Terry to draw this design. (Hint: Use an angle which measures 150 degrees in the BIGSPIRAL procedure.)



```
?TO SWIRLS
>FULLSCREEN
>SETBG 1 SETPC 0
_____
_____
_____
```

**3.** Teach Terry to draw a design with four identical spirals.

## Read with Terry



When Terry first appears on your monitor, the turtle is in the middle of the screen pointing straight up. This position is called the HOME position. When Terry is in the HOME position, the turtle's HEADING is 0. This means that Terry is heading or pointing to the 0 degree mark on an imaginary compass on your screen.

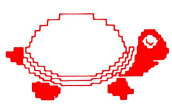
You can turn Terry to point to any position on the screen by using the SETHEADING command. If you type SETHEADING 90, Terry will point to the right side of the screen. SETHEADING 180 will make Terry point to the bottom of the screen.

You can use this information about HEADINGs in procedures. Here is Nan's procedure to teach Terry to draw a recursive design with squares. First, she taught Terry to SQUARE :SIDE, then she typed this procedure:

```
?TO DESIGNSQUARE :SIDE :ANGLE
>SQUARE :SIDE
>FD :SIDE RT :ANGLE
>IF HEADING = 0 [STOP]
>DESIGNSQUARE :SIDE :ANGLE
>END
```

This procedure teaches Terry to make designs with squares. Terry will continue to draw squares, move forward, and turn until the turtle's heading is 0. Then, Terry will stop.

## Write with Terry



1. Florence typed SETHEADING 360. Where did Terry point to on the screen?

   _____

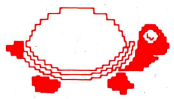
2. James typed SETHEADING 270. Where did Terry point to on the screen?

   _____

3. When will Terry stop drawing Nan's procedure?

   _____

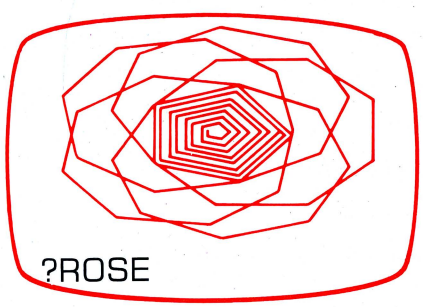
## Draw with Terry



**1.** Look at the turtle drawing below. Then write the missing lines to teach Terry to draw this design. (Hint: Use TRIANGLE :SIDE instead of SQUARE :SIDE to write a DESIGNTRI procedure.)

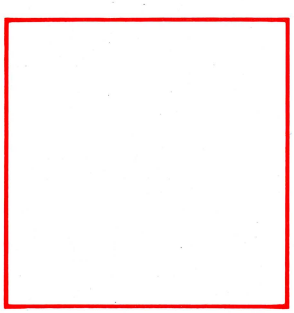
```
?TO DESIGNTRI :SIDE :ANGLE
_____
>FD :SIDE
>RT :ANGLE
_____
_____
>HT
_____
```

**2.** Write the missing lines to teach Terry to draw this design. (Hint: Use an octagon in place of the square in the DESIGNSQUARE procedure. Terry knows how to SMSPIRAL.)




```
?TO DESIGNOCT :SIDE :ANGLE
_____
>FD :SIDE
>RT :ANGLE
_____
_____
>END
?TO ROSE
>DESIGNOCT 40 72
_____
>END
```

**3.** Teach Terry to draw a design made of hexagons called DESIGNHEX. Draw Terry's picture below. Write your procedure on the lines.

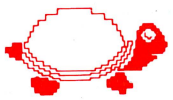


```
_____
_____
_____
_____
_____
_____
```

# CHAPTER 10: Turtle Projects

## LESSON 1

### Read with Terry



Marla wanted to teach Terry to draw a jack o'lantern. She planned to teach the turtle to draw a pumpkin head, two triangular eyes, a nose, and a jagged mouth. Marla decided that the best way to approach this problem was to teach Terry four procedures, one each for the head, eyes, nose, and mouth of the jack o'lantern. Then, she could test each part of the drawing separately to see if Terry was drawing the jack o'lantern correctly. Here is Marla's procedure.

```
?TO PUMPKIN
>FULLSCREEN
>HT
>NOSE
>EYES
>MOUTH
>HEAD
>END
?TO NOSE
>PU HOME RT 90 FD 25
  LT 90 BK 10 PD
>LT 90
>SMSPIRAL 25 120 1
>END
```

Marla used a FULLSCREEN to make a large pumpkin. She hid the turtle before Terry started to draw. This helps Terry draw designs faster.

Then the turtle looked for the directions for the procedure named NOSE. Terry continued to follow the directions in the procedure named PUMPKIN until each step was completed.

Marla found that writing a complicated procedure as a set of smaller procedures helped her find and correct mistakes more easily. These smaller procedures are called **subprocedures.**

### Write with Terry

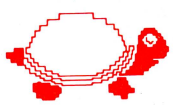
1. How many subprocedures are in the PUMPKIN procedure?

   _____

2. Why is it helpful to write subprocedures?

   _____

### Terry's Drawings



Marla had Terry draw the NOSE from the PUMPKIN procedure. Can you write the subprocedures to draw the EYES, MOUTH, and HEAD?

## Draw with Terry

**1.** Read the procedure below. Then draw Terry's picture on the sample screen.

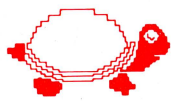
```
?TO WHEELS
>PU BK 30 PD
>DESIGNTRI 30 45
>PU LT 90 FD 75 RT 90 PD
>DESIGNTRI 30 45
>END
```

**2.** Look at Terry's drawing below. Then write the missing lines to teach Terry to draw this design.

```
?TO H
>FD 60 BK 30
_____
>FD 30 LT 90
_____
_____
>END
?TO MOVE
>PU RT 90 FD 30 LT 90 PD
>END
?TO I
>RT 90 FD 5 BK 10 FD 5
_____
>RT 90 FD 5 BK 10
_____
>END
?TO HI
_____
_____
_____
>END
```

**3.** Teach Terry to draw a stick figure of a girl. Use subprocedures for the head, body, skirt, arms, and legs.

## Read with Terry



Now that you can use a set of subprocedures, you can teach the turtle to draw an entire scene. Here is a list of the procedures Norma used to teach Terry to draw a house.

```
?TO HOUSE
>ROOF
>FRAME
>WINDOWS
>DOOR
>CHIMNEY
>END
```

The procedure HOUSE is called a **superprocedure.** Superprocedures are plans that call for each of the separate procedures.

Norma's plan uses the title HOUSE as the superprocedure. Her plans for the house include each of the five separate subprocedures. Norma wrote the instructions for each subprocedure, then she used a superprocedure to teach Terry to draw each part of the house.

## Write with Terry

1. What is the title of Norma's procedure?

   _____

2. How many subprocedures did Norma write?

   _____

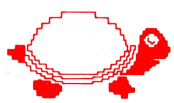
3. What is the name of the superprocedure in Norma's program?

   _____

4. Which part of the house will Terry draw first?

   _____

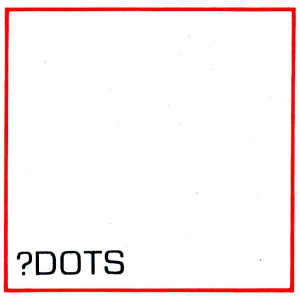
## Terry's Drawings



Sean wrote a superprocedure named SHAPES. The subprocedures in his program were named TRIANGLE, SQUARE, PENTAGON, HEXAGON, and MOVE. Use these subprocedures to teach Terry to draw a different design.

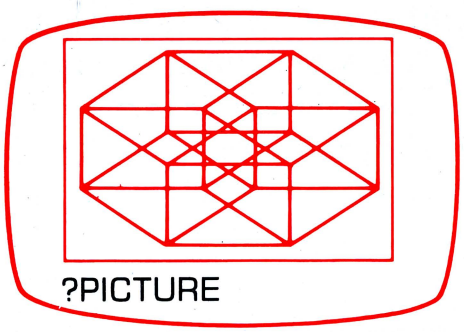
## Draw with Terry

1. Read the procedure below. Then draw Terry's picture on the sample screen.




```
?TO DOTS
>CIRCLE1
>MOVE
>CIRCLE2
>END
?TO CIRCLE1
>REPEAT 180 [FD 1 RT 2]
>END
?TO CIRCLE2
>REPEAT 36 [FD 1 RT 10]
>END
```

2. Look at Terry's drawing below. Then write the missing lines to teach Terry to draw this design. (Hint: Terry knows how to DESIGNSQUARE.)

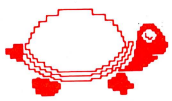



```
?TO STAINEDGLASS
>PU LT 90 FD 50 RT 90
_____
>DESIGNSQUARE 50 45
>HT
_____
?TO FRAME
>PU LT 90 FD 15
>RT 90 FD 100 PD
_____
_____
>END
?TO PICTURE
_____
_____
_____
```

3. Teach Terry to draw a stick figure of a boy next to the stick figure of the girl on page 61.

# LESSON 3

## Read with Terry



Matthew created many different pictures with superprocedures and subprocedures, but he found that editing his procedures could be quite a chore. Typing CTRL-F and CTRL-B moved the cursor Forward and Back, but there were many times he had to move the cursor up or down several lines of directions. Matthew found several more editing commands:

| COMMAND | MOVEMENT |
|---|---|
| CTRL-N | Moves the cursor dowN one line. |
| CTRL-P | Moves the cursor uP one line. |
| CTRL-A | Moves the cursor to the start of the line. |
| CTRL-E | Moves the cursor to the End of the line. |

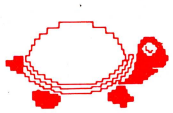
Here is how Holly used these commands.

```
?TO BOAT
>LT 45
>TRIAGLE 100
>SETHEADING 225
>FD 30
>RT 45
>FD 60
>SETHEADING320
>FD 30
>END■
```

Holly pressed CTRL-P seven times to bring the cursor to TRIAGLE 100. Then she pressed CTRL-F to move the cursor to the G, and typed the letter N. The second line of the procedure was now corrected to read TRIANGLE 100.

Holly put a space between the command SETHEADING and the number 320 by pressing CTRL-N five times, and using CTRL-F to move the cursor to the number 3. Finally, she pressed the space bar once. The line now reads SETHEADING 320.

## Write with Terry



**1.** To move the cursor to the end of a line, you should press

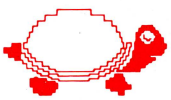
a. CTRL-B
b. CTRL-E
c. CTRL-A

**2.** Circle the easiest way to fix this procedure.

```
?TO SEASCENE
>BOAT
>LT 45 DF 60
>BOAT
>END■
```

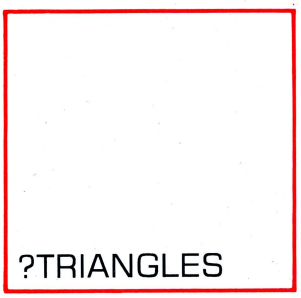
a. Press CTRL-N and CTRL-F.
b. Press CTRL-A and CTRL-E.
c. Press CTRL-P and CTRL-A.

## Draw with Terry

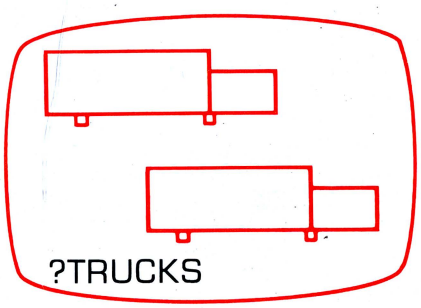


**1.** Read the procedure below. Then draw Terry's picture on the sample screen.

```
?TO TRIANGLES
>TRIANGLE 100
>MOVE
>TRIANGLE 50
>MOVE
>TRIANGLE 30
>END
```




**2.** Look at the turtle drawing below. Then write the missing lines to teach Terry to draw this picture. (Hint: Terry knows how to SQUARE :S and RECT :L :W.)



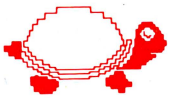

```
?TO TRUCKS
_____
_____
>TRUCK
>END
?TO WHEEL
>REPEAT 18 [FD 1 LT 20]
>END
?TO TRUCK
>HT PU LT 90 FD 75 PD
>RECT 50 30
>RT 90
_____
>LT 90
_____
_____
_____
>END
?TO MOVETRUCK
>PU LT 160 FD 200 LT 110 PD
>END
```

**3.** Use the TRUCKS procedure as part of a superprocedure named STREETSCENE. Write procedures to teach Terry to draw streetlights, a street, and a stop sign.

# CHAPTER 11: Logo Words and Numbers

## LESSON 1

### Read with Terry



Here is how to teach Terry to write words.

```
?TO TERRY
>PRINT "TERRY
>PRINT "CAN
>PRINT "WRITE
>PRINT "XG32Y
>END
```

```
TERRY
CAN
WRITE
XG32Y
?■
```

The name of this procedure is Terry. The first line tells Terry to PRINT the word TERRY. The second and third lines tell the turtle to print CAN and WRITE. The last line tells Terry to print the word XG32Y. Terry thinks any group of letters or numbers which follows a single quote (") and ends with a space is a word. When you type the name of this procedure and press RETURN, your screen will look like the screen above.

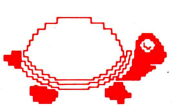
Here is how Chuck taught Terry to combine Logo words.

```
?TO NEWWORDS
>PRINT (WORD "BAN "AN "A )
>PRINT "
>PRINT (WORD "TAIL "OR )
>END
```

```
BANANA

TAILOR
?■
```

The command PRINT (WORD "BAN "AN "A ) tells Terry to make one word from the three words inside the parentheses. Notice that each of the words begins with a single quote (") and ends with a space. The command PRINT " tells Terry to print a blank line on the screen. (The command PRINT [] will also print a blank line.) Above is the message Terry left on Chuck's screen. To clear the screen, Chuck typed CLEARTEXT.

### Write with Terry



1. Write a command which tells Terry to print the word FLASH-DANCE on your screen.

   _____

2. What is a Logo word?

   _____

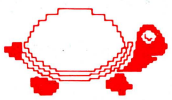
3. Write a command to print a blank line on your screen.

_____

4. Write a command which teaches Terry to combine the words SUN and DAY into one word.

_____

## Work with Terry



1. Read the procedure below. Then look at the sample screen and fill in the missing output.

```
?TO MESSAGE
>PRINT "HELLO.
>PRINT "
>PRINT "LOGO
>PRINT "IS
>PRINT "FUN!
>END
?MESSAGE
```

```
HELLO.
_____
_____
IS
_____
?■
```

2. Look at the sample screen. Then write the missing lines to teach Terry to produce this output.

```
ASTRONAUTS

JOHN
GLENN

SALLY
RIDE

NEIL
ARMSTRONG
?■
```

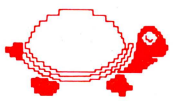
```
?TO ASTRONAUTS
_____
>PRINT "
_____
_____
_____
>PRINT "SALLY
_____
_____
_____
>PRINT "ARMSTRONG
>END
```

3. Write a procedure to teach Terry to write your first, middle, and last names on your screen. Tell Terry to leave a blank line between each name.

_____

# LESSON 2

## Read with Terry



Denise typed the command PRINT 20 * 5. Then she pressed RETURN. Terry responded by printing the number 100 on her screen. Can you guess what happened?

The PRINT command is also used to tell Terry to print the answer to an arithmetic problem. Denise did not use a single quotation mark in the command PRINT 20 * 5. The turtle knows that numbers and an operation sign following PRINT is a command to print the answer to the problem. Here are the operation signs Terry knows.

```
+  (plus sign)   – tells Terry to add.
–  (minus sign)  – tells Terry to subtract.
/  (slash)       – tells Terry to divide.
*  (asterisk)    – tells Terry to multiply.
```

Terry can also perform operations such as 2 + (3 * 7). First, Terry performs the operation inside the parentheses. Then, the turtle performs any multiplication or division outside the parentheses. Finally, Terry performs any addition or subtraction outside the parentheses.

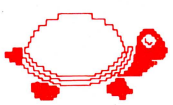
Terry will also print numbers without computing answers. Here are three ways Denise taught Terry to print 1 to 4.

```
?TO COUNT
>PRINT "1
>PRINT "2
>PRINT "3
>PRINT "4
>END
```

```
?TO FASTCOUNT
>PRINT "1234
>END
```

```
?TO COUNT2
>PRINT (WORD "1 "2 "3 "4 )
>END
```

## Write with Terry



**1.** Write Terry's output for each.

a. PRINT 3 + 6 _____

b. PRINT 15 / 5 _____

c. PRINT 2 * 7 _____

d. PRINT 1 + (4 / 2) _____

**2.** Terry displayed a 6 on the screen. Circle each statement that would produce this output.

a. PRINT "6

b. PRINT (WORD "3 + "3 )

c. PRINT 12 / 2

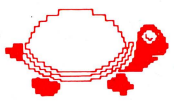
**3.** Barbara wrote the statement PRINT (3 + 8) * 4.

a. Which operation would Terry perform first?

_____

b. What is the output of this statement? _____

## Work with Terry



**1.** Read the procedure below. Then look at the sample screen and write the missing output.

```
?TO SKIPCOUNT
>PRINT "SKIPCOUNT
>PRINT "2
>PRINT 2 + 2
>PRINT 2 + 2 + 2
>PRINT 2 + 2 + 2 + 2
>END
```

```
_____
2
_____
_____
8
```

**2.** Look at the sample screen. Then write the missing lines to teach Terry to produce this output. (Hint: You must use the numbers 0, 2, and 4 in each statement.)

```
THREE
NUMBERS
6
8
2
0
```

```
?TO THREENUMBERS
_____
_____
>PRINT (2 + 4) - 0
_____
_____
>PRINT (4 * 0) * 2
>END
```

**3.** Write the missing lines to teach Terry to produce this output. (Hint: Squares are the products of any number multiplied by itself, such as 8 * 8.)

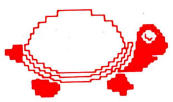
```
SQUARES
1
4
9
16
25
```

```
?TO SQUARES
_____
_____
_____
_____
>PRINT 4 * 4
_____
>END
```

**4.** Write a program to teach Terry to find the answers to three addition problems.

# LESSON 3

## Read with Terry



Angelo wrote a procedure called JUMBLE to teach Terry to print certain letters of any word. Here is Angelo's procedure.

```
?TO JUMBLE :WORD
>PRINT FIRST :WORD
>PRINT LAST :WORD
>PRINT BUTFIRST :WORD
>END
```

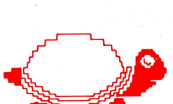
The title of the procedure uses a variable :WORD. This tells Terry that different words can be used. Angelo decided to use the word HAPPY. He ran the procedure by typing JUMBLE "HAPPY. Look at the output. Can you see what Terry did?

```
?JUMBLE "HAPPY
H          —H is the FIRST letter of the word HAPPY.
Y          —Y is the LAST letter of the word HAPPY.
APPY       —APPY are all the letters BUT the FIRST of the word
?■           HAPPY.
```

Terry knows that a word is a series of letters, numbers, or characters that begins with a single quote and ends with a space. Each letter, number, or character in the word is called an **element.** Here are some commands that Terry can use to pick out any element of a word.

```
PRINT FIRST "CAT      —Terry prints the FIRST element of the word—C.
PRINT LAST "CAT       —Terry prints the LAST element of the word—T.
PRINT BUTFIRST "CAT   —Terry prints all BUT the FIRST element of the word—
                        AT.
PRINT BUTLAST "CAT    —Terry prints all BUT the LAST element of the word—
                        CA.
```

## Write with Terry



1. How many elements are found in the word OCTOPUS?

   _____

2. Which command would you use to print the OG from the word DOG?

   _____

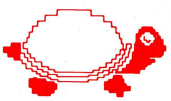
3. Clara used Angelo's program with the word THAT. What command did she give Terry to output HAT?

_____

4. Steve used Angelo's program with the word HEART. What command did he give Terry to output HEAR?

_____

## Work with Terry



1. Read the procedure below. Then write the missing output on the sample screen.

```
?TO NUMBERMIX :WORD
>PRINT :WORD
>PRINT BUTLAST :WORD
>PRINT FIRST :WORD
>PRINT BUTFIRST :WORD
>END
```

```
?NUMBERMIX "362
362
_____
_____
62
```

2. Look at the output on the sample screen. Then write the missing lines to teach Terry to produce this output.

```
?BUILDING "AIR "PORT
AIRPORT

T
R
A
P
```

```
?TO BUILDING :A :B
>PRINT (WORD :A :B )
>PRINT "
_____
_____
>PRINT FIRST :A
_____
>END
```

3. Write the missing lines to teach Terry to produce this output.

```
?NUMBERMAGIC "40 "20 "60
80
20
120
602040
```

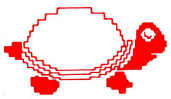
```
?TO NUMBERMAGIC :A :B :C
>PRINT :A * 2
_____
_____
_____
>END
```

4. Write a procedure to teach Terry to use the letters O, S, P, and T to make four different words. Use four different variables in your procedure.

# CHAPTER 12: Logo Lists and Sentences

## LESSON 1

### Read with Terry



Scott knew that he could teach Terry to use the PRINT command to display his first, middle and last names on the screen. But Terry would write each of these names on a separate line. Scott wanted all three names on one line. Terry can do this by using a **list.**

A Logo list is a set of words which are separated by spaces. This set is enclosed within a set of brackets ( [] ). The words in a Logo list are each called an element. These elements do not need a single quotation mark before each. The spaces tell Terry where each word begins and ends.

Scott's list is written below. He typed his full name inside brackets. Spaces are used to separate each name. After he pressed RETURN, the words SCOTT THOMAS CHUNG were displayed on one screen line.

```
?PRINT [SCOTT THOMAS CHUNG]        <RETURN>
SCOTT THOMAS CHUNG
```

Scott found that he could work with the elements in a list just as he did with the elements in a word. Here is a procedure he wrote to use elements in a list.

```
?TO MYNAME :NAME
>PRINT :NAME
>PRINT LAST :NAME
>PRINT FIRST :NAME
>PRINT FIRST BUTFIRST :NAME
>END
```

```
?MYNAME [SCOTT THOMAS CHUNG]
SCOTT THOMAS CHUNG
CHUNG
SCOTT
THOMAS
?■
```

Did you notice the command PRINT FIRST BUTFIRST? This tells Terry to print the second element in the list. BUTFIRST is the command that tells Terry to print all BUT the FIRST element. The FIRST element BUT the FIRST is the second element in the list. Above is the output of the MYNAME :NAME program.

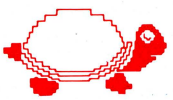
### Write with Terry

1. How many elements are in the list [MARTIN LUTHER KING JR.]? _____
2. PRINT LAST BUTLAST [20 60 40]
   Which number will be displayed? _____

3. Write a command to print the word CAT from the list [DOG CAT BIRD SNAKE].

_____

## Work with Terry



1. Read the procedure below. Then write the missing output on the sample screen.

```
?TO MIXEDNUMBERS :X
>PRINT :X
>PRINT LAST :X
>PRINT FIRST :X
>PRINT FIRST BUTFIRST :X
>END
```

```
?MIXEDNUMBERS [5 6 4]
_____
_____
5
_____
```

2. Look at the output on the sample screen. Then write the missing lines to teach Terry to display this output.

```
?NOISES [GIGGLE SNORT CHOMP
 MEOW]
THESE ARE THE NOISES YOU
 MAKE:
SNORT CHOMP MEOW
THESE ARE THE NOISES I MAKE:
GIGGLE SNORT CHOMP
```

```
?TO NOISES :A
_____
>PRINT BUTFIRST :A
_____
_____
>END
```

3. Write the missing lines to teach Terry to produce this output.

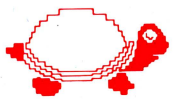
```
?GAMES [CHECKERS SOCCER
 JACKS BONGOS]
I LIKE TO PLAY
SOCCER

MY BROTHER LIKES TO PLAY
BONGOS

MY SISTER LIKES TO PLAY
JACKS
```

```
?TO GAMES :TYPE
_____
>PRINT FIRST BUTFIRST :TYPE
>PRINT []
_____
_____
_____
_____
_____
>END
```

4. Write a program to teach Terry to pick names of cities from a list and use these in statements such as "I LIVE IN _____", "MY MOTHER COMES FROM _____", etc.

# LESSON 2

## Read with Terry



Jill enjoyed teaching Terry to work with lists, but she wanted the turtle to work with more than one list at a time. Logo lets you put two or more lists together into a bigger list. This is called a **sentence.** A Logo sentence is not like an English sentence. It does not have to begin with a capital letter and end with a period. A Logo sentence is just a way to combine words and lists into larger lists. Here is one way to do this.

```
PRINT SENTENCE [LOGO LISTS CAN BE COMBINED]
 [INTO A LARGER LIST]
```

After you press RETURN, the turtle will display this message.

```
LOGO LISTS CAN BE COMBINED INTO A LARGER
LIST
```

Here is how Jill used two lists in a procedure. She used two variables in her procedure name because she used two lists.

```
?TO CAPITALS :C :D
>PRINT SENTENCE LAST :C
  [ IS THE CAPITAL OF ]
>PRINT FIRST :D
>PRINT []
>PRINT SENTENCE FIRST :C
  [ IS THE CAPITAL OF ]
>PRINT FIRST BUTFIRST :D
>END
```

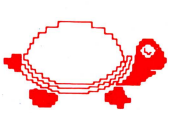
```
?CAPITALS [PARIS LONDON ROME]
 [ITALY FRANCE ENGLAND]
ROME IS THE CAPITAL OF
ITALY

PARIS IS THE CAPITAL OF
FRANCE
?
```

Using Logo sentences helped Jill write an interesting procedure. Logo sentences can also be made by combining two words or a word and a list. Here are examples of combining two words and combining a word and a list.

```
?PRINT SENTENCE
 "MICHAEL "JACKSON
MICHAEL JACKSON
```

```
?PRINT SENTENCE
 "TERRY [THE TURTLE]
TERRY THE TURTLE
```

## Write with Terry



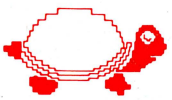
1. What is a Logo sentence?

   _____

2. A Logo sentence will combine two lists into _____.
3. Write a command to combine the words JULY and FOURTH.

   _____

## Work with Terry



**1.** Read the procedure below. Then write the missing output on the sample screen.

```
?TO DESERTS :A
>PRINT SENTENCE [DESERTS ARE]
  FIRST :A
>PRINT SENTENCE [DESERTS ARE]
  LAST :A
>PRINT SENTENCE [DESERTS ARE]
  FIRST BUTFIRST :A
>END
```

```
?DESERTS [DRY SANDY SUNNY HOT]
DESERTS ARE DRY
_____
_____
```

**2.** Look at the output on the sample screen. Then write the missing lines to teach Terry to display this output. (Hint: SE is an abbreviation for sentence.)

```
?SCIENTISTS [ALBERT JONAS
 MARIE] [CURIE EINSTEIN SALK]
THREE FAMOUS SCIENTISTS
 ARE:

ALBERT EINSTEIN
MARIE CURIE
JONAS SALK
```

```
?TO SCIENTISTS :F :L
_____
_____
>PRINT SE FIRST :F FIRST BUTFIRST
  :L
_____
_____
>END
```

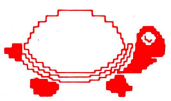
**3.** Write the missing lines to teach Terry to produce this output.

```
?COMBINATIONS "WHAT
WHAT GROW ON TREES?
WHAT GROW IN BUNCHES?
WHAT HAVE THICK SKINS?

BANANAS!
```

```
_____
_____
>PRINT SE :P [GROW IN BUNCHES?]
_____
_____
_____
>END
```

**4.** Write a procedure to teach Terry to join a list of colors and a list of clothes into Logo sentences.

## Read with Terry



Here is a procedure for a word game that Jessica wrote. She taught Terry to print any list typed by the user twice. Jessica used the abbreviation PR for the command PRINT.

```
?TO DOUBLE :T
>PR [I CAN SAY IT TWICE!]
>PR []
>PR SE :T :T
>END
```

The PR SE :T :T command tells Terry to take the word or list input as :T and PRINT it twice. Here are two different outputs from the same program. Jessica wrote the list [I LOVE LOGO!] for the value of the variable in the first output. Then she used the words [DOUBLE TROUBLE] as the value of :T in the second program.

```
?DOUBLE [I LOVE LOGO!]
I CAN SAY IT TWICE!

I LOVE LOGO! I LOVE LOGO!
?■
```

```
?DOUBLE [DOUBLE TROUBLE]
I CAN SAY IT TWICE!

DOUBLE TROUBLE DOUBLE TROUBLE
?■
```

Jessica also wrote a procedure to remove letters from a word and print the remainder of the word until all the letters were removed. Here is her DISAPPEAR procedure.

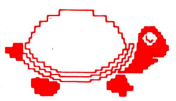
```
?TO DISAPPEAR :W
>IF EMPTYP :W [STOP]
>PRINT :W
>DISAPPEAR BUTLAST :W
>END
```

```
?DISAPPEAR "MARIO
MARIO
MARI
MAR
MA
M
```

The command EMPTYP tests to see if the word or the list is EMPTY. If all the letters have been removed by the BUTLAST command, the word is EMPTY, and Terry stops the program.

Above is Jessica's output. Terry printed the word MARIO. Then the turtle printed all but the last letter of this word. Terry continued to remove the last letter and print the remaining letters until the word was EMPTY.

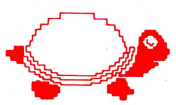
## Write with Terry



1. Circle the commands which are written correctly.
   a. PT SE :A :A
   b. PR ST :A :A
   c. PRINT SENTENCE :A :A
   d. PR. SENTENCE :A :A
2. Rewrite the command PR SE :T :T to teach Terry to write the list four times.

_____

## Work with Terry



1. Read the procedure below. Then write the missing output on the sample screen.

```
?TO GREETING :NAME
>PR SE [HELLO, ] :NAME
>PR SE [I LIKE THE NAME ]
  :NAME
>PR SE [I LIKE IT ENOUGH
  TO WRITE IT TWICE ]
>PR SE :NAME :NAME
>END
```

```
?GREETING "BONNIE
_____
I LIKE THE NAME BONNIE
_____
_____
?■
```

2. Write the missing lines to teach Terry to produce this output.

```
?OLYMPICS [SKIING SWIMMING
  DIVING SKATING]
MY FAVORITE IS SKATING
I ALSO LIKE SKIING SWIMMING
  DIVING
BUT TO ME, THE THREE BEST
  ARE
SKATING

SKATING

AND SKATING
```

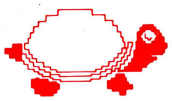
```
?TO OLYMPICS :E
_____
>PR SE [I ALSO LIKE] BUTLAST :E
_____
_____
>PR []
_____
>PR []
_____
>END
```

3. Write a procedure to teach Terry to write four sentences about a classroom. Use a list to name some of the objects in a classroom. Have Terry use each of these objects in the sentences.

# CHAPTER 13: Using MAKE

## LESSON 1

### Read with Terry



You have used variables to send Terry information about things. There is another way of naming objects in Logo. You can use the MAKE command.

The MAKE command lets you decide on a piece of information and then find a name for that information. Using the MAKE command lets you use numbers, words, or lists as variables in your procedures. You need two kinds of information to use the MAKE command: the **name** of the variable, and the **value** of the variable. Here is how Wendy used the MAKE command.

```
?MAKE "PERSON 500   – This assigns the value 500 to
                      the variable PERSON.
?PR :PERSON         – This tells Terry to PRINT the
                      value of PERSON.
500                 – The value of PERSON is 500.
```

You can use a word with the MAKE command. Here is how:

```
?MAKE "CITY "DALLAS – This assigns the value DAL-
                      LAS to the variable CITY.
?PR :CITY           – This tells Terry to PRINT the
                      value of CITY.
DALLAS              – The value of CITY is DALLAS.
```

Finally, you can use a list with the MAKE command:

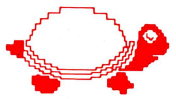
```
?MAKE "LIKE [PEAS AND PIZZA]
?PRINT :LIKE
PEAS AND PIZZA
```

In this case, the list [PEAS AND PIZZA] is assigned as the value of the variable word LIKE. The variable name LIKE can be used to build a sentence. Here is how Wendy did it.

```
?MAKE "LIKE [PEAS AND PIZZA]
?MAKE "LIKE SE :LIKE [TASTE GOOD]
?PRINT :LIKE
PEAS AND PIZZA TASTE GOOD
```

In the second line, Wendy assigned a sentence to LIKE. The first part of the sentence is the first value of LIKE. The second part of the sentence is the list [TASTE GOOD].

## Write with Terry



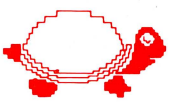
1. Name three things that can be assigned to a variable with the MAKE command.

_____

2. Don wrote the command MAKE "NO 25. Then he typed PR :NO. What did Terry print?

_____

## Work with Terry



1. Read the procedure below. Then write the missing output on the sample screen.

```
?TO BUILDNUMBERS
>PR [BUILDING NUMBERS]
>MAKE "NUM 10
>PR :NUM
>MAKE "NUM :NUM * 2
>PR :NUM
>MAKE "NUM :NUM * 2
>PR :NUM
>END
```

```
BUILDING NUMBERS
_____
_____
_____
?■
```

2. Write the missing lines to teach Terry to produce this output.

```
CATS, DOGS, AND HORSES WALK.
BIRDS, BEES, AND FLIES FLY.
FISH, WHALES, AND DOLPHINS
  SWIM.
?■
```

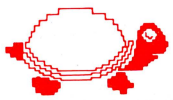
```
?TO ANIMALWORLD
>MAKE "LAND [CATS, DOGS, AND
  HORSES]
_____
_____
_____
_____
>PR :AIR
_____
>MAKE "SEA SE :SEA [SWIM.]
_____
>END
```

3. Write a procedure to teach Terry to use the MAKE command. Multiply 50 by 10 until the number 5000 is reached.

_____

# LESSON 2

## Read with Terry



There are computer programs that let you type a message and then reply to the message you typed. Now you will learn to write procedures like those. Here is a procedure Mark wrote.

```
?TO TERRY
>PR [HELLO, WHAT IS YOUR NAME?]
>MAKE "ANSWER READLIST
>PR SE [WELCOME TO TERRY'S WORLD,] :ANSWER
>END
```

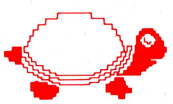
The first line tells Terry to PR the message HELLO, WHAT IS YOUR NAME?

The second line assigns READLIST to the variable ANSWER. READLIST is a Logo command. When Terry sees the command READLIST, the turtle stops running the program until the user types a response. This response is then assigned to the variable ANSWER. If you wish, you can use RL as an abbreviation for READLIST.

The third line tells Terry to PR a sentence with the list [WELCOME TO TERRY'S WORLD,] and the value of the variable ANSWER. Here is the output of Mark's procedure.

```
HELLO, WHAT IS YOUR NAME?
MARK
WELCOME TO TERRY'S WORLD, MARK
```

## Write with Terry



1. Which Logo command stops the procedure until the user types a response?

   _____

2. What is the abbreviation for READLIST? _____
3. Circle the statements which are written correctly.

   a. MAKE "REPLY READLIST
   b. MAKE "REPLY [READLIST]
   c. MAKE "NAME "REDLIST
   d. MAKE "NAME READLIST

4. Write a statement which will tell Terry to assign the user's response to the variable name ENTRY.

   _____

## Work with Terry

**1.** Read the procedure below. Then write the missing output on the sample screen.

```
?TO NEWGREET
>PR [WHAT IS YOUR NAME?]
>MAKE "REPLY READLIST
>PR SE [HELLO,] :REPLY
>PR [MY NAME IS TERRY]
>PR [WE HAVE A LOT TO
  LEARN TOGETHER]
>END
```

```
WHAT IS YOUR NAME?
ANN
HELLO, ANN
MY NAME IS TERRY
WE HAVE A LOT TO LEARN TOGETHER
?■
```

**2.** Look at the output on the sample screen. Then write the missing lines to teach Terry to produce this output.

```
HOW OLD ARE YOU?
12
IN WHICH STATE DO YOU LIVE?
NEBRASKA
NOW I KNOW ABOUT YOU.
YOUR AGE IS 12
YOU LIVE IN NEBRASKA
```

```
?TO QUESTIONS
_____
>MAKE "AGE READLIST
_____
_____
_____
>PR SE [YOUR AGE IS ] :AGE
_____
>END
```

**3.** Write the missing lines to teach Terry to produce this output.

```
WHAT IS YOUR FAVORITE
  COLOR?
RED
WHAT OTHER COLOR DO YOU
  LIKE?
PURPLE
I LIKE THOSE COLORS, TOO.
MY ROOM IS PAINTED BRIGHT
  RED
MY HOUSE IS PURPLE
?■
```

```
?TO COLORS
_____
_____
_____
>MAKE "ANSWER READLIST
_____
>PR SE [MY ROOM IS PAINTED
  BRIGHT] :REPLY
_____
>END
```

**4.** Write a program to teach Terry to talk with a friend about television shows. Be sure Terry uses your friend's answers.

# LESSON 3

## Read with Terry

The READLIST command can also be used to help you add, subtract, multiply, or divide a number typed in by a user. You will have to write two separate procedures to teach Terry to operate on a number input by a user. Here is how Debbie wrote a procedure to teach Terry to add the number 6 to any reply.

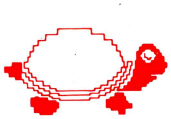
```
?TO OLDER
>PR [HOW OLD ARE YOU?]
>PR YEARS FIRST READLIST
>PR [I AM 6 YEARS OLDER.]
>END
?TO YEARS :AGE
>OP SE [I AM ] :AGE + 6
>END
```

The second statement, PR YEARS FIRST READLIST, sends Terry to the procedure named YEARS. This procedure tells Terry to look for a number variable and call this number :AGE. Terry will store the FIRST number input by the user as :AGE through the READLIST command in the OLDER procedure.

The user's number is stored, and Terry reads the first line in the YEARS procedure. This line tells Terry to OUTPUT (OP) a SENTENCE (SE) made of two lists. The first list is [I AM], and the second list is the number input by the user + 6. After Terry displays this sentence, the turtle moves to the next line in the OLDER procedure. Here is Debbie's output.

```
HOW OLD ARE YOU?      — Terry prints the first line of
                         OLDER.
11                    — The user types a number.
I AM 17               — Terry moves to YEARS, and
                         adds 6 to the number.
I AM 6 YEARS OLDER.   — Terry moves back to OLDER
?■                       and prints the sentence.
```

## Write with Terry



1. What is the abbreviation for OUTPUT? _____

**2.** José used the statement PR INCHES FIRST READLIST in a procedure named HEIGHT. What was the name of the procedure he wrote to store the input as a number?

_____

## Work with Terry

Look at the output on the sample screen. Then write the missing lines to teach Terry to produce this output.

```
I CAN DOUBLE ANY NUMBER.
TYPE A NUMBER.
57
YOUR NUMBER DOUBLED IS 114
?■
```

```
?TO NEWNUMBER
_____
_____
>PR TIMES2 FIRST READLIST
>END
?TO TIMES2 :X
_____
>END
```

**2.** Write the missing lines to teach Terry to produce this output. (Hint: Square a number by multiplying the number by itself: $A^2 = A * A$. Cube a number by multiplying it by itself three times: $A^3 = A * A * A$.)

```
HERE ARE TWO WAYS I CAN
CHANGE ANY NUMBER.

TYPE ANY NUMBER.
23
YOUR NUMBER SQUARED
IS 529

TYPE YOUR NUMBER AGAIN.
23
YOUR NUMBER CUBED
IS 12167
?■
```

```
?TO CHANGES
_____
>PR []
_____
>PR SQUARES FIRST RL
>PR []
_____
>PR CUBES FIRST RL
>END
?TO SQUARES :A
_____
>END
_____
_____
>END
```

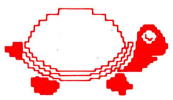
**3.** Write a program to teach Terry to ask a user to type a secret number. Terry should add 5 to the number, tell the user Terry's number is 5 more, and display the turtle's number.

_____

# CHAPTER 14: Using Conditionals

## LESSON 1

### Read with Terry



Carrie wrote several procedures to teach Terry to take a reply from a user and use this reply in the turtle's response. Now she wants to teach Terry to look for a certain answer and ignore any other answer. Carrie did this by using the TEST command. Here is her procedure.

```
?TO GUESSNAME
>PR [HI. I'M THE LOGO TURTLE.]  – Prints the first message.
>PR [TYPE MY NAME.]             – Prints the second message.
>TEST READLIST = [TERRY]        – TESTs the input to see if it is TERRY.
>IFTRUE [PR [THAT'S MY NAME!]]  – If it is TRUE that the RL = TERRY, the mes-
>END                               sage THAT'S MY NAME! is printed. If the RL
                                   does not = TERRY, the program ends.
```

Did you notice the way Carrie used brackets in the fourth line of her procedure? THAT'S MY NAME! is a list. It must be enclosed by brackets. The command PR must be separated from the IFTRUE statement. Logo uses brackets to separate them. Carrie knew that she had to use the same number of left and right brackets, so her statement ends with two right brackets.

Here are two sample screens showing Carrie's procedure.

```
?GUESSNAME
HI. I'M THE LOGO TURTLE.
TYPE MY NAME.
TERRY
THAT'S MY NAME!
```

```
?GUESSNAME
HI. I'M THE LOGO TURTLE.
TYPE MY NAME.
TOMMY
```

### Write with Terry

1. Seth wrote the statement TEST READLIST = [GREEN]. Which word is he teaching Terry to identify?

   _____

2. Another line in Seth's procedure was IFTRUE [PR [YES!]]. What will Terry display if the user's input is PURPLE?

   _____

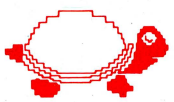
3. Write a statement to teach Terry to look for the word SATURN as the input.

   _____

4. Write a statement to print THAT IS THE PLANET. if the user types SATURN as the input.

_____

## Work with Terry



1. Read the procedure below. Then write the missing output on the sample screen.

```
?TO SECRETWORD
>PR [MY SECRET WORD HAS THREE
  LETTERS.]
>PR [IT IS THE NAME OF A COLOR.]
>PR [TYPE MY SECRET WORD.]
>TEST READLIST = [RED]
>IFTRUE [PR [RED IS MY SECRET
  WORD.]]
>END
```

```
?SECRETWORD
_____
IT IS THE NAME OF A COLOR.
_____
RED
_____
?■
```

2. Write the missing lines to teach Terry to produce this output.

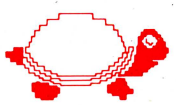
```
?CHOICES
IN WHICH DIRECTIONS CAN TERRY
 TURN?
A.  UP AND DOWN
B.  RIGHT AND LEFT
C.  FORWARD AND BACK

TYPE THE LETTER OF THE CORRECT
  ANSWER.
B
YOU'RE RIGHT.
?■
```

```
?TO CHOICES
_____
_____
>PR [B. RIGHT AND LEFT]
_____
>PR []
_____
_____
>IFTRUE [PR [YOU'RE RIGHT.]]
_____
```

3. Write a procedure to teach Terry to ask the user for the name of the largest state in the United States. If the user types ALASKA the turtle should display the words, YES, ALASKA IS THE LARGEST STATE.

# LESSON 2

## Read with Terry



Zoe wanted to teach Terry to give two possible replies to a user's input. She wanted the turtle to display one message if the reply was correct and display a different message if the reply was incorrect. Here is Zoe's procedure.

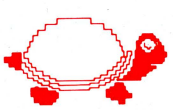
```
?TO MAMMALS
>PR [WHAT IS THE LARGEST MAMMAL?]
>TEST READLIST = [WHALE]
>IFTRUE [PR [THAT'S CORRECT.]]
>IFFALSE [PR [THE LARGEST MAMMAL
  IS A WHALE.]]
>END
```

This procedure teaches Terry to look for the word WHALE. If the user's reply is WHALE, Terry will print the message THAT'S CORRECT. If the user's reply is anything but the word WHALE, Terry will print the message THE LARGEST MAMMAL IS A WHALE. Here are two different outputs:

```
?MAMMALS
WHAT IS THE LARGEST MAMMAL?
WHALE
THAT'S CORRECT.
```

```
?MAMMALS
WHAT IS THE LARGEST MAMMAL?
ELEPHANT
THE LARGEST MAMMAL IS A
  WHALE.
```

## Write with Terry



1. Rick typed the word CANOE in reply to a question Terry asked. Then Terry displayed the message THAT'S CORRECT. Write the statement that tested Rick's answer and the statement that told Terry which message to display.

_____

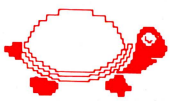
_____

2. Sandy typed the word SAILBOAT and received the reply NO, THE WORD IS CANOE. Write the statement that tested Sandy's reply and the statement that taught Terry which message to display.

_____

_____

## Work with Terry



**1.** Read the procedure below. Then write the missing output on the sample screen.

```
?TO MOONWALK
>PR [WHO WAS THE FIRST HUMAN
  TO WALK ON THE MOON?]
>PR [TYPE HIS LAST NAME.]
>TEST READLIST = [ARMSTRONG]
>IFTRUE [PR [RIGHT.]]
>IFFALSE [PR [NO. IT WAS ARM-
  STRONG.]]
>END
```

```
?MOONWALK
WHO WAS THE FIRST HUMAN TO WALK
  ON THE MOON?
_____
GLENN
_____
```

**2.** Look at the output on the sample screen. Then write the missing lines to teach Terry to produce this output.

```
?PLANETQUIZ
WHICH PLANET IS CLOSEST TO THE
  SUN?
NEPTUNE
NO, MERCURY IS CLOSEST TO THE
  SUN.

?PLANETQUIZ
WHICH PLANET IS CLOSEST TO THE
  SUN?
MERCURY.
RIGHT. IT IS ALSO THE HOTTEST.
```

```
?TO PLANETQUIZ
_____
>TEST READLIST = [MERCURY]
_____
_____
>END
```

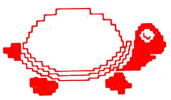
**3.** Write the missing lines to teach Terry to produce this output.

```
?LOGOQUIZ

WHAT SHAPE IS TERRY?
TRIANGLE
RIGHT. THE TURTLE IS A TRIANGLE.
?
```

```
?TO LOGOQUIZ
_____
_____
_____
>IFFALSE [PR [TERRY IS A TRIANGLE.]]
>END
```

**4.** Write a procedure to teach Terry to ask the user a question about your school. Give one message for a correct answer and another for an incorrect answer.

## Read with Terry



Brad had a spinner with the numbers 1 to 10 written on it. He decided to teach Terry to act like the spinner and print the numbers 1 to 10 in a random way. Terry can do this by using the RANDOM command.

The RANDOM command tells Terry to pick a number between 0 and 1 less than the number you type. If you type RANDOM 10, Terry will pick a number between 0 and 9. You must type RANDOM 11 to teach Terry to pick numbers between 0 and 10.

Brad wanted to write a procedure to allow the user to tell Terry how many numbers to pick. He wrote this procedure:

```
?TO SPINNER :NUMBER
>IF :NUMBER = 0 [STOP]
>RANDOM 11
>SPINNER :NUMBER - 1
>END
```

```
?SPINNER 4
6
2
9
3
```

The variable :NUMBER allows the user to decide how many random numbers Terry should display. The first line of the procedure tells Terry that if the amount stored in :NUMBER is 0, the turtle should STOP the procedure. The second line of the procedure tells Terry to pick numbers between 1 and 10. The third line of the procedure is a recursion. It tells Terry to execute the procedure until the value stored in :NUMBER is 0. Above is one output of Brad's program.

There is no order to random numbers. Terry will pick any number between 0 and the number following the RANDOM command. You may get different numbers with Brad's procedure.

## Write with Terry

1. Between which numbers will Terry choose random numbers if you type the command RANDOM 101?

   _____

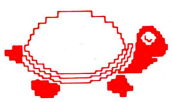
2. The output from Elise's procedure ranged from 0 to 50. What command did she use to display these numbers?

   _____

3. Brenda used Brad's procedure to teach Terry to display 50 random numbers. What command did she use to do this?

_____

## Work with Terry



1. Read the procedures below. Then write the missing output on the blank lines.

```
?TO SCORES :TIMES
>PR [WHO HAS THE HIGHER
  SCORE?]
>PR [ADD THE SCORES AND FIND
  OUT!]
>GENERATE :TIMES
>END

?TO GENERATE :TIMES
>IF :TIMES = 0 [STOP]
>MAKE "A RANDOM 10
>PR SE [MY SCORE IS ] :A
>MAKE "B RANDOM 10
>PR SE [YOUR SCORE IS ] :B
>GENERATE :TIMES - 1
>END
```

```
?SCORES 4
_____
_____
MY SCORE IS 4
YOUR SCORE IS 6
_____
_____
_____
_____
MY SCORE IS 8
_____
```

2. Write the missing lines to teach Terry to produce this output.

```
?GAME
I AM THINKING OF A NUMBER.
IT IS BETWEEN 1 AND 20.
GUESS MY NUMBER.
13
MY NUMBER IS 4
WERE YOU RIGHT?
NO
BETTER LUCK NEXT TIME.
```

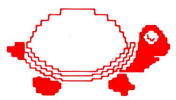
```
?TO GAME
_____
_____
_____
>MAKE "A READLIST
_____
>PR [WERE YOU RIGHT?]
>TEST READLIST = [YES]
>IFTRUE [PR [GOOD FOR YOU.]]
_____
>END
```

3. Write a program that uses random numbers between 0 and 100. Design a game with these numbers.

# CHAPTER 15: More about Conditionals

## LESSON 1

### Read with Terry



THING is a Logo command which outputs the value of a variable. If you type the statements

```
?MAKE "HONEY 10
?PR THING "HONEY
```

Terry will display a 10. This is the value of the "thing" contained in HONEY. Here is how Wilma used this command to help her write a procedure to reverse a word or a list.

```
?TO TURNAROUND :THING
>IF EMPTYP :THING [PR [] STOP]
>TYPE LAST :THING
>IF LISTP :THING [TYPE CHAR 32]
>TURNAROUND BL :THING
>END
```

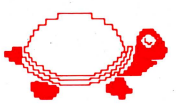
The title uses the Logo word THING. This tells Terry to expect an input which may be a word or a list. The second line uses the term EMPTYP to tell Terry to check for an EMPTY list or word. If the input is an EMPTY, Terry will print a blank list and STOP. The third line tells Terry to type the LAST element of :THING. The fourth line tells Terry to see if the LIST is empty. If true, Terry will type CHAR 32, which is a space. Finally, the fifth line tells Terry to repeat this process with the next to last BUTLAST (BL) element :THING.

Here are two outputs of Wilma's procedure.

```
?TURNAROUND "SPOT
TOPS
```

```
?TURNAROUND [CATS AND DOGS]
DOGS AND CATS
```

### Write with Terry



1. What does the word LISTP tell Terry?

   _____

2. What does the word EMPTYP tell Terry?

   _____

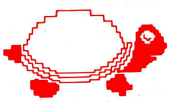
3. What does the Logo word THING tell Terry?

_____

4. What does the term TYPE CHAR 32 tell Terry?

_____

## Work with Terry



1. Read the procedure below. Then write the missing output on the sample screen. (Hint: Terry knows the TURNAROUND :THING procedure.)

```
?TO BACKTALK :THING
>PR [I CAN SAY YOUR WORD BACK-
  WARDS.]
>TURNAROUND :THING
>PR [CAN YOU SPEAK BACK-
  WARDS, TOO?]
>TEST READLIST = [YES]
>IFTRUE [PR [DOOG ROF UOY]]
>IFFALSE [PR [PRACTICE!]]
>END
```

```
?BACKTALK "HEAD
_____
DAEH
_____
NO
_____
?■
```

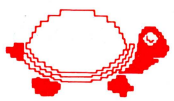
2. Look at the output on the sample screen. Then write the missing lines to teach Terry to produce this output.

```
?NUMBACK 456
MY NUMBER IS THE REVERSE OF
  YOUR NUMBER.
MY NUMBER IS:
654
```

```
?TO NUMBACK :THING
_____
>PR [MY NUMBER IS:]
_____
>END
```

3. Write a procedure which accepts a two-digit number from a user and reverses it. Then the reversed number should be reversed once again and the original number displayed on the screen.

## Read with Terry



You have used the IF statement in many different ways. This Logo word has helped you teach Terry to decide which message to display on the screen. It has also helped you teach Terry when to stop a procedure. When Terry executes a recursive procedure, the turtle keeps executing the procedure until you press CTRL-G or until the turtle meets a condition defined by the IF statement. Here's another way to use IF in a procedure.

```
?TO COUNTHUNDRED :X
>LABEL "COUNT
>IF :X > 100 [STOP]
>PRINT :X
>MAKE "X :X + 5
>GO "COUNT
>END
```

```
?COUNTHUNDRED 71
71
76
81
86
91
96
```

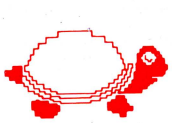
The word LABEL is always used with the word GO. These two words pass control of the procedure back and forth between them. As soon as Terry reads the word LABEL, the turtle follows all instructions until it meets the word GO. This is repeated until the condition defined by the IF statement is met.

In the program above, Terry will take a number, print the number, and add five to the number until the number is greater than 100. Then Terry will stop the procedure. Look at the output above from this program.

This procedure printed the number 71, and added 5 to the number. Terry continued to add 5 to each number until the number was greater than 100. Terry did not print this number. The turtle simply stopped the procedure.

The words LABEL and GO can also be used to teach Terry to print a message a certain number of times.

## Write with Terry



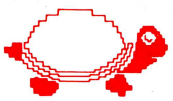
1. Which Logo word must always be used with LABEL? _____
2. Write a statement to change the COUNTHUNDRED procedure to count by 7 to 100.

_____

3. Write a statement to change the COUNTHUNDRED procedure so Terry will stop the procedure after 24 times.

_____

## Work with Terry



1. Read the procedure. Then look at the sample screen and fill in the missing lines.

```
?TO BESTFRIEND
>PR [TYPE THE NAME OF YOUR
  BEST FRIEND]
>PR [I WILL WRITE IT 5 TIMES.]
>MAKE "A READLIST
>MAKE "T 0
>LABEL "START
>IF :T = 6 [STOP]
>PRINT :A
>MAKE "T :T + 1
>GO "START
>END
```

```
?BESTFRIEND
_____
I WILL WRITE IT 5 TIMES.
_____
_____
_____
_____
_____
_____
```

2. Write the missing lines to teach Terry to produce this output.

```
?COUNTBACK 20
20
15
10
5
0
```

```
?TO COUNTBACK :X
_____
_____
>PRINT :X
>MAKE "X :X - 5
_____
>END
```

3. Write the missing lines to teach Terry to produce this output.

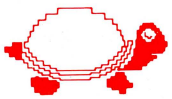
```
?MULT 4
4
20
100
```

```
?TO MULT :Q
>LABEL "YES
>IF :Q > 100 [STOP]
_____
_____
_____
>END
```

4. Write a procedure to teach Terry to print your name six times, then print your friend's name six times.

_____

## Read with Terry

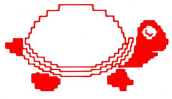


You have now used IF as a control statement in a loop, and as part of the IFTRUE and IFFALSE statements. IF can also be used to control the flow of procedures outside of a loop. Here is how Phil used multiple IF statements to control a procedure.

```
?TO DISCUSSION
>PR [IN WHICH CITY DO YOU LIVE?]
>MAKE "REPLY READLIST
>IF :REPLY = [MIAMI] [PR [I THINK FLORIDA HAS BEAU-
  TIFUL WEATHER.] STOP]
>IF :REPLY = [MINNEAPOLIS] [PR [I'VE HEARD ABOUT
  THE BEAUTIFUL LAKES THERE.] STOP]
>PR (SE [I HOPE I CAN VISIT YOU IN ] :REPLY "SOON.)
>END
```

As you can see, this procedure takes the user's reply and uses it to decide which message to print on the screen. If the user inputs MIAMI or MINNEAPOLIS, a message about that city will be displayed on the screen. The last statement in this procedure will allow Terry to reply to any input. It is always a good idea to put a statement in your procedures to reply to an input you may not be expecting.

## Write with Terry



1. The last statement in this procedure prints a sentence from a list, a variable, and a word. Write a statement to print the list I HOPE YOU HAVE FUN IN, the variable :CITY, and the word TODAY as a Logo sentence.

   _____

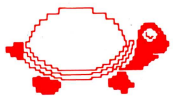
2. Write a statement to print a Logo sentence from the word MY, the variable :RELATIVE, and the list [WOULD LOVE TO VISIT YOU, ALSO].

   _____

3. Look at Phil's procedure again. What words will be displayed on the screen if the user types SEATTLE?

   _____

## Work with Terry



**1.** Read the procedure below. Then look at the screen and write the missing output.

```
?TO SPORTS
>PR [WHAT IS YOUR FAVORITE
  SPORT?]
>MAKE "RESPONSE READLIST
>IF :RESPONSE = [SOCCER] [PR
  [THAT IS A ROUGH GAME!] STOP]
>IF :RESPONSE = [BASEBALL] [PR
  [I AM AN ORIOLES FAN.] STOP]
>PR [SE [MY FAVORITE SPORT IS]
  :RESPONSE "TOO.]
>END
```

```
?SPORTS
_____
HOCKEY
_____
?■
?SPORTS
_____
SOCCER
_____
?■
```

**2.** Write the missing lines to teach Terry to produce this output.

```
?SINGERS
WHO IS YOUR FAVORITE MALE
  SINGER?
WRITE HIS FIRST AND LAST NAME
  WITHOUT ANY SPACES.
MICHAELJACKSON
I THINK HIS THRILLER ALBUM IS
 GREAT!
?■
```

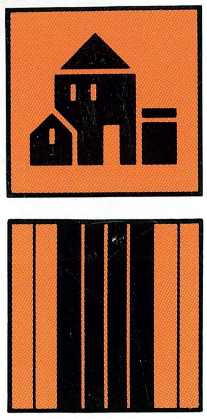
```
?TO SINGERS
>PR [WHO IS YOUR FAVORITE MALE
  SINGER?]
_____
_____
_____
>IF :ANS = [BOYGEORGE] [PR [HE
  LIKES TO WEAR HATS.] STOP]
>PR [SE [I LIKE ] :ANS "TOO.]
>END
```

**3.** Write the missing lines to teach Terry to produce this output.

```
?SUBJECTS
WHICH IS YOUR FAVORITE SUB-
  JECT?
MATH
I ALSO LIKE MATH — ESPECIALLY
 GEOMETRY!
?■
```

```
?TO SUBJECTS
_____
_____
>IF :REPLY = [SCIENCE] [PR [HAVE YOU
  STUDIED BIOLOGY YET?] STOP]
_____
>PR [SE :REPLY [IS A GREAT SUBJECT.]]
>END
```

**4.** Write a procedure to teach Terry to reply to the question WHICH IS YOUR FAVORITE TV SHOW? Write at least five IF statements in your procedure. Be sure to include a statement to display a message if the user types an answer you didn't expect.



# Things to Remember about Logo

Be sure to place your Logo disk in the disk drive before you start.
Press RETURN after each direction you give the turtle.
These commands will be useful as you write your programs:

| | | |
|---|---|---|
| FORWARD | FD 50 | Moves the turtle forward 50 steps. |
| BACK | BK 75 | Moves the turtle back 75 steps. |
| RIGHT | RT 45 | Turns the turtle 45 degrees to the right. |
| LEFT | LT 90 | Turns the turtle 90 degrees to the left. |
| REPEAT | REPEAT 4 [FD 35 RT 90] | Tells the turtle to follow the same direction more than once. (This direction will form a square.) |
| CLEARSCREEN | CS | Clears the screen and moves the turtle to its home position at the center of the screen. |
| PENUP | PU | Puts the turtle's pen in an up position so that it doesn't draw any lines. |
| PENDOWN | PD | Puts the turtle's pen in a down position so that it can draw lines. |
| PENERASE | PE | Turns the turtle's pen into an eraser so that it can erase any lines on the screen that you tell it to. |
| EDIT | EDIT "BOX | Allows you to use the Logo Editor to write a procedure named BOX, or to edit the procedure named BOX. |
| PRINT | PR "HELLO | Prints the word HELLO on the screen. |
| SENTENCE | PR SE [LOGO IS ONE] [COMPUTER LANGUAGE] | Combines two Logo lists into one sentence. |
| MAKE | MAKE "CITY "DALLAS | Assigns the value DALLAS to the variable CITY. |

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